15.5 Grenades

Munitions listed in this section begin with the Department of Defense Identification Code (DODIC) letter "G." Almost all munitions included in this category are grenades. Examples include fragmentation grenades, incendiary grenades, and smoke grenades.

15.5.1 G878, M228 Practice Hand Grenade Fuse

15.5.1.1 Ordnance Description[1,2]

The M228 Practice Hand Grenade Fuse (DODIC G878) is used with the M69 practice hand grenade to simulate the look, weight, and feel of the M67 series of fragmentation hand grenades. When functioned, the M228 Practice Hand Grenade Fuse emits a puff of white smoke and makes a loud popping noise after a delay of 4 to 5 seconds. This ammunition is used on firing ranges during training; it is not used during combat.

The M228 Practice Hand Grenade Fuse consists of a primer and a pyrotechnic delay column. Attached to the body of the fuse are a striker, striker spring, safety lever, safety pin and pull ring, safety clip, and a detonator assembly.

15.5.1.2 Emissions And Controls[1-4]

The primary emissions from the use of the M228 Practice Hand Grenade Fuse are carbon dioxide (CO_2) and particulate matter. Other criteria pollutants, hazardous air pollutants as defined by the *Clean Air Act* (CAA), and toxic chemicals (i.e., those chemicals regulated under Section 313 of the *Emergency Planning and Community Right-to-Know Act* [EPCRA]) are emitted at low levels. As this ordnance is typically used in the field, there are no controls associated with its use.

Table 15.5.1-1 presents emission factors for CO_2, criteria pollutants, total nonmethane hydrocarbons (TNMHC), and total suspended particulate (TSP). Table 15.5.1-2 presents emission factors for hazardous air pollutants and toxic chemicals. In both tables, the emission factors are presented in units of pounds of emissions per item (lb per item) and in units of pounds of emissions per pound net explosive weight contained in the item (lb per lb NEW).

Table 15.5.1-1 EMISSION FACTORS FOR THE USE OF DODIC G878, M228 PRACTICE HAND GRENADE FUSE – CARBON DIOXIDE, CRITERIA POLLUTANTS, TOTAL NONMETHANE HYDROCARBONS, AND TOTAL SUSPENDED PARTICULATE[a]

EMISSION FACTOR RATING: B (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
124-38-9	CO_2	1.7 E-04	3.8 E-02
630-08-0	Carbon monoxide (CO)[f]	1.1 E-05	2.4 E-03
--	Oxides of nitrogen (NO_X)	4.0 E-05	8.7 E-03
--	PM-2.5[d]	9.4 E-05	2.0 E-02
--	PM-10[e]	1.1 E-04	2.3 E-02
7446-09-5	Sulfur dioxide (SO_2)[f]	1.1 E-05	2.3 E-03
--	TNMHC[f]	3.2 E-07	6.9 E-05
12789-66-1	TSP	1.2 E-04	2.6 E-02

[a] Factors represent uncontrolled emissions. References 1-4.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 4.50 E-03 pounds per item. References 1 and 5.
[d] PM-2.5 = particulate matter with an aerodynamic diameter equal to or less than 2.5 micrometers (μm).
[e] PM-10 = particulate matter with an aerodynamic diameter equal to or less than 10 μm.
[f] EMISSION FACTOR RATING C.

Table 15.5.1-2 EMISSION FACTORS FOR THE USE OF DODIC G878, M228 PRACTICE HAND GRENADE FUSE – HAZARDOUS AIR POLLUTANTS AND TOXIC CHEMICALS[a]

EMISSION FACTOR RATING: C (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
107-02-8	Acrolein[d]	3.0 E-08	6.4 E-06
7664-41-7	Ammonia[e]	3.5 E-07	7.6 E-05
7440-39-3	Barium[e]	5.2 E-06	1.1 E-03
71-43-2	Benzene[d]	4.6 E-08	9.9 E-06
75-15-0	Carbon disulfide[d]	2.7 E-08	5.9 E-06
7782-50-5	Chlorine[d,f]	6.1 E-07	1.3 E-04
7440-47-3	Chromium[d]	2.1 E-06	4.6 E-04
--	Total dioxin/furan compounds[d]	3.1 E-13	6.8 E-11
74-85-1	Ethylene[e]	4.8 E-08	1.0 E-05
117-81-7	bis(2-Ethylhexyl)phthalate[d]	1.9 E-08	4.2 E-06
50-00-0	Formaldehyde[d]	1.2 E-07	2.6 E-05
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin[d]	5.4 E-14	1.2 E-11
75-09-2	Methylene chloride[d]	4.6 E-08	1.0 E-05
7440-02-0	Nickel[d]	7.0 E-07	1.5 E-04
3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin[d]	2.0 E-13	4.3 E-11
39001-02-0	1,2,3,4,6,7,8,9-Octachlorodibenzofuran[d]	6.1 E-14	1.3 E-11
108-95-2	Phenol[d]	4.3 E-09	9.4 E-07
115-07-1	Propylene[e]	1.5 E-08	3.3 E-06
7440-22-4	Silver[e]	2.4 E-09	5.1 E-07
108-88-3	Toluene[d]	9.6 E-09	2.1 E-06
7440-66-6	Zinc[e]	5.7 E-07	1.2 E-04

[a] Factors represent uncontrolled emissions. References 1-4.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 4.50 E-03 pounds per item. References 1 and 5.
[d] Reportable chemical under EPCRA Section 313 and a hazardous air pollutant under CAA Section 112(b).
[e] Reportable chemical under EPCRA Section 313.
[f] EMISSION FACTOR RATING D.

References For Section 15.5.1

1. *Sampling Results for AEC Phase VI Emission Characterization of Exploding Ordnance and Smoke/Pyrotechnics,* URS Group, Inc., Oak Ridge, TN, April 2006.

2. *Detailed Test Plan for Phase VI Emission Characterization of Exploding Ordnance and Smoke/Pyrotechnics*, West Desert Test Center, U.S. Army Dugway Proving Ground, UT, June 2004.

3. Supporting information including Excel spreadsheets supplied upon request by the U.S. Army Dugway Proving Ground test support contractor, URS Group, Inc., Oak Ridge, TN, February 2007.

4. *Background Document, Report on Revisions to 5th Edition AP-42 Chapter 15 - Ordnance Detonation, Emission Factors Developed Based on Phase VI Testing Conducted at Dugway Proving Ground, Utah*, MACTEC Federal Programs, Inc., Research Triangle Park, NC, June 2008.

5. *Munitions Items Disposition Action System (MIDAS)* website, https://midas.dac.army.mil/, U.S. Army Defense Ammunition Center, McAlester, OK, December 2007.

15.5.2 G881, M67 Fragmentation Hand Grenade

15.5.2.1 Ordnance Description[1]

The M67 Fragmentation Hand Grenade (DODIC G881) is used to supplement small arms fire in close combat. The grenade produces casualties by high velocity projection of fragments in a uniform distribution pattern. This ammunition is used during combat and on firing ranges during training.

The M67 Fragmentation Hand Grenade consists of a 2.5 inch diameter steel sphere. A M213 pyrotechnic delay-detonating fuse is used to function the grenade four to five seconds after a safety lever is released. The body of the fuse contains a primer and a pyrotechnic delay column. Attached to the body of the fuse are a striker, striker spring, safety lever, safety pin and pull ring, safety clip, and a detonator assembly.

15.5.2.2 Emissions And Controls[1-5]

Carbon dioxide (CO_2) is the primary pollutant emitted from the use of the M67 Fragmentation Hand Grenade. Criteria pollutants, hazardous air pollutants as defined by the *Clean Air Act* (CAA), and toxic chemicals (i.e., those chemicals regulated under Section 313 of the *Emergency Planning and Community Right-to-Know Act* [EPCRA]) are emitted at low levels. As this ordnance is typically used in the field, there are no controls associated with its use.

Table 15.5.2-1 presents emission factors for CO_2, criteria pollutants, methane, and total suspended particulate (TSP). Table 15.5.2-2 presents emission factors for hazardous air pollutants and toxic chemicals. In both tables, the emission factors are presented in units of pounds of emissions per item (lb per item) and in units of pounds of emissions per pound net explosive weight contained in the item (lb per lb NEW).

Table 15.5.2-1 EMISSION FACTORS FOR THE USE OF DODIC G881, M67 FRAGMENTATION HAND GRENADE – CARBON DIOXIDE, CRITERIA POLLUTANTS, METHANE, AND TOTAL SUSPENDED PARTICULATE[a]

EMISSION FACTOR RATING: C

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
124-38-9	CO_2	2.4 E-01	5.7 E-01
630-08-0	Carbon monoxide (CO)	1.7 E-02	4.2 E-02
7439-92-1	Lead (Pb)	5.0 E-04	1.2 E-03
74-82-8	Methane	2.8 E-04	6.8 E-04
--	Oxides of nitrogen (NO_X)	1.1 E-03	2.7 E-03
--	PM-2.5[d]	1.7 E-02	4.3 E-02
--	PM-10[e]	3.1 E-02	7.5 E-02
12789-66-1	TSP	3.8 E-02	9.2 E-02

[a] Factors represent uncontrolled emissions. References 1, 2, and 5.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 4.1 E-01 pounds per item. Reference 1.
[d] PM-2.5 = particulate matter with an aerodynamic diameter equal to or less than 2.5 micrometers (μm).
[e] PM-10 = particulate matter with an aerodynamic diameter equal to or less than 10 μm.

Table 15.5.2-2 EMISSION FACTORS FOR THE USE OF DODIC G881,
M67 FRAGMENTATION HAND GRENADE –
HAZARDOUS AIR POLLUTANTS AND TOXIC CHEMICALS[a]

EMISSION FACTOR RATING: C (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
83-32-9	Acenaphthene[d]	1.2 E-08	3.0 E-08
208-96-8	Acenaphthylene[d]	7.9 E-08	1.9 E-07
75-05-8	Acetonitrile[e]	3.4 E-05	8.2 E-05
107-13-1	Acrylonitrile[e]	1.3 E-06	3.3 E-06
7429-90-5	Aluminum[f]	2.7 E-04	6.7 E-04
120-12-7	Anthracene[e]	1.5 E-08	3.7 E-08
7440-38-2	Arsenic[e]	5.8 E-06	1.4 E-05
7440-39-3	Barium[f]	7.1 E-05	1.7 E-04
71-43-2	Benzene[e]	4.1 E-06	9.9 E-06
56-55-3	Benzo[a]anthracene[e]	3.2 E-09	7.9 E-09
85-68-7	Butylbenzylphthalate[d]	2.4 E-06	5.8 E-06
7440-47-3	Chromium[e]	1.1 E-05	2.8 E-05
218-01-9	Chrysene[e]	6.0 E-09	1.5 E-08
7440-50-8	Copper[f]	5.9 E-05	1.4 E-04
57-12-5	Particulate cyanide[e,g]	2.1 E-05	5.2 E-05
84-74-2	Dibutyl phthalate[e]	2.8 E-06	6.8 E-06
75-71-8	Dichlorodifluoromethane[f]	4.3 E-08	1.1 E-07
--	Total dioxin/furan compounds[e]	2.7 E-10	6.5 E-10
74-85-1	Ethylene[f]	2.3 E-05	5.7 E-05
117-81-7	bis(2-Ethylhexyl)phthalate[e,g]	1.6 E-05	3.9 E-05
206-44-0	Fluoranthene[e]	4.0 E-08	9.7 E-08
86-73-7	Fluorene[d]	1.4 E-08	3.3 E-08
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin[e]	2.3 E-11	5.6 E-11
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran[e]	2.4 E-12	5.9 E-12
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran[e]	2.8 E-13	6.8 E-13
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin[e]	1.3 E-13	3.2 E-13
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin[e]	7.1 E-13	1.7 E-12
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin[e]	5.5 E-13	1.3 E-12
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran[e]	5.6 E-13	1.4 E-12
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran[e]	2.8 E-13	6.8 E-13

Table 15.5.2-2 (cont.)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran[e]	2.1 E-13	5.0 E-13
74-90-8	Hydrogen cyanide[e]	4.2 E-04	1.0 E-03
7439-92-1	Lead[e]	5.0 E-04	1.2 E-03
7439-96-5	Manganese[e]	3.8 E-05	9.4 E-05
91-20-3	Naphthalene[e]	7.5 E-07	1.8 E-06
7697-37-2	Nitric acid[f]	5.8 E-05	1.4 E-04
3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin[e]	2.4 E-10	5.8 E-10
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran[e]	2.1 E-13	5.0 E-13
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran[e]	3.5 E-13	8.5 E-13
85-01-8	Phenanthrene[e]	9.7 E-08	2.4 E-07
115-07-1	Propylene[f]	6.4 E-06	1.6 E-05
129-00-0	Pyrene[d]	7.4 E-08	1.8 E-07
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran[e]	8.9 E-13	2.2 E-12
108-88-3	Toluene[e]	4.3 E-07	1.1 E-06
75-69-4	Trichlorofluoromethane[f]	3.0 E-07	7.3 E-07
95-63-6	1,2,4-Trimethylbenzene[f]	4.0 E-07	9.8 E-07
106-42-3, 108-38-3	m-Xylene, p-Xylene[e]	1.7 E-07	4.2 E-07
95-47-6	o-Xylene[e]	9.8 E-08	2.4 E-07
7440-66-6	Zinc[f]	3.8 E-03	9.2 E-03

[a] Factors represent uncontrolled emissions. References 1, 2, and 5.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 4.1 E-01 pounds per item. Reference 1.
[d] Hazardous air pollutant under CAA Section 112(b).
[e] Reportable chemical under EPCRA Section 313 and a hazardous air pollutant under CAA Section 112(b).
[f] Reportable chemical under EPCRA Section 313.
[g] EMISSION FACTOR RATING D.

References For Section 15.5.2

1. *Report No. 1 for the Exploding Ordnance Emission Study Phase II, Revision 1*, Military Environmental Technology Demonstration Center, U.S. Army Aberdeen Test Center, Aberdeen Proving Ground, MD, December 2004.

2. *Detailed Test Plan No. 1 for the Exploding Ordnance Emission Study, Series I*, Military Environmental Technology Demonstration Center, U.S. Army Aberdeen Test Center, Aberdeen Proving Ground, MD, December 2000.

3. *Hazard Classification of United States Military Explosives and Munitions*, U.S. Army Defense Ammunition Center, Logistics Review and Technical Assistance Office, McAlester, OK, Revision 11, February 2001.

4. *Background Document, Report on Revisions to 5th Edition AP-42 Chapter 15 - Ordnance Detonation, Emission Factors Developed Based on Exploding Ordnance Emission Study Phase II Series 1 Testing Conducted at Aberdeen Proving Ground, Maryland*, MACTEC Federal Programs, Inc., Research Triangle Park, NC, July 2006.

5. Supporting information including Excel spreadsheets, analytical results, field notes, and case summaries supplied upon request by the Applied Science Test Team - Chemistry Unit, U.S. Army Aberdeen Test Center, Aberdeen Proving Ground, MD, May 2004.

This page left blank intentionally.

15.5.3 G900, TH3 AN-M14 Incendiary Grenade

15.5.3.1 Ordnance Description[1]

The Thermite (TH3) AN-M14 Incendiary Grenade (DODIC G900) is primarily used to provide a source of intense heat (up to 4,000ºF) to destroy equipment. It will fuse the metallic parts of any object that it contacts. This ammunition is used during combat and on firing ranges during training.

The TH3 AN-M14 Incendiary Grenade consists of a 5.7 inch long cylinder that contains a percussion primer, first-fire mixture, fuse delay element, ignition mixture, grenade starter mixture, and incendiary mixture. Attached to the body of the grenade are a striker, striker spring, safety lever, and safety pin with pull ring. When the safety lever is released, the striker strikes the percussion primer, and the first-fire mixture, fuse delay element, ignition mixture, grenade starter mixture, and incendiary mixture are initiated in turn by the preceding component.

15.5.3.2 Emissions And Controls[1-5]

The primary emissions from the use of the TH3 AN-M14 Incendiary Grenade are particulate matter, sulfur dioxide (SO_2), carbon dioxide (CO_2), and lead. Other criteria pollutants, hazardous air pollutants as defined by the *Clean Air Act* (CAA), and toxic chemicals (i.e., those chemicals regulated under Section 313 of the *Emergency Planning and Community Right-to-Know Act* [EPCRA]) are emitted at low levels. As this ordnance is typically used in the field, there are no controls associated with its use.

Table 15.5.3-1 presents emission factors for CO_2, criteria pollutants, methane, and total suspended particulate (TSP). Table 15.5.3-2 presents emission factors for hazardous air pollutants and toxic chemicals. In both tables, the emission factors are presented in units of pounds of emissions per item (lb per item) and in units of pounds of emissions per pound net explosive weight contained in the item (lb per lb NEW).

Table 15.5.3-1 EMISSION FACTORS FOR THE USE OF DODIC G900, TH3 AN-M14 INCENDIARY GRENADE – CARBON DIOXIDE, CRITERIA POLLUTANTS, METHANE, AND TOTAL SUSPENDED PARTICULATE[a]

EMISSION FACTOR RATING: B (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
124-38-9	CO_2[f]	2.1 E-02	1.4 E-02
630-08-0	Carbon monoxide (CO)	8.0 E-04	5.1 E-04
7439-92-1	Lead (Pb)[g]	1.1 E-02	7.0 E-03
74-82-8	Methane	1.2 E-05	7.9 E-06
--	Oxides of nitrogen (NO_X)[f]	6.7 E-04	4.3 E-04
--	PM-2.5[d]	4.9 E-02	3.1 E-02
--	PM-10[e,g]	7.0 E-02	4.5 E-02
7446-09-5	SO_2[g]	2.6 E-02	1.7 E-02
12789-66-1	TSP[g]	6.8 E-02	4.4 E-02

[a] Factors represent uncontrolled emissions. References 1, 2, and 5.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 1.55 pounds per item. Reference 1.
[d] PM-2.5 = particulate matter with an aerodynamic diameter equal to or less than 2.5 micrometers (μm).
[e] PM-10 = particulate matter with an aerodynamic diameter equal to or less than 10 μm.
[f] EMISSION FACTOR RATING A.
[g] EMISSION FACTOR RATING C.

Table 15.5.3-2 EMISSION FACTORS FOR THE USE OF DODIC G900, TH3 AN-M14 INCENDIARY GRENADE – HAZARDOUS AIR POLLUTANTS AND TOXIC CHEMICALS[a]

EMISSION FACTOR RATING: C (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
83-32-9	Acenaphthene[d,h]	4.2 E-09	2.7 E-09
208-96-8	Acenaphthylene[d,h]	3.2 E-08	2.1 E-08
75-07-0	Acetaldehyde[d,h]	2.1 E-06	1.4 E-06
75-05-8	Acetonitrile[e,h]	1.6 E-07	1.0 E-07
98-86-2	Acetophenone[e,i]	2.5 E-06	1.6 E-06
107-02-8	Acrolein[e]	8.3 E-07	5.4 E-07
7429-90-5	Aluminum[f,h]	4.8 E-03	3.1 E-03
120-12-7	Anthracene[e,h]	2.4 E-09	1.6 E-09
7440-39-3	Barium[f]	2.8 E-03	1.8 E-03
71-43-2	Benzene[e,h]	2.0 E-06	1.3 E-06
56-55-3	Benzo[a]anthracene[e]	2.4 E-09	1.6 E-09
205-99-2	Benzo[b]fluoranthene[e]	6.2 E-09	4.0 E-09
207-08-9	Benzo[k]fluoranthene[e]	3.9 E-09	2.5 E-09
191-24-2	Benzo[g,h,i]perylene[e]	3.6 E-09	2.3 E-09
50-32-8	Benzo[a]pyrene[e]	2.7 E-09	1.8 E-09
75-15-0	Carbon disulfide[e,i]	1.6 E-07	1.0 E-07
75-00-3	Chloroethane[e,i]	2.6 E-07	1.7 E-07
74-87-3	Chloromethane[e,h]	7.5 E-08	4.8 E-08
7440-47-3	Chromium[e,h]	5.4 E-06	3.5 E-06
218-01-9	Chrysene[e]	4.6 E-09	3.0 E-09
7440-50-8	Copper[f,h]	5.2 E-05	3.4 E-05
75-71-8	Dichlorodifluoromethane[f,h]	4.6 E-08	2.9 E-08
117-81-7	bis(2-Ethylhexyl)phthalate[e,g]	3.6 E-05	2.3 E-05
206-44-0	Fluoranthene[e,h]	7.8 E-09	5.0 E-09
86-73-7	Fluorene[d,h]	1.0 E-08	6.6 E-09
74-90-8	Hydrogen cyanide[e]	4.9 E-06	3.2 E-06
193-39-5	Indeno[1,2,3-cd]pyrene[e]	3.9 E-09	2.5 E-09
7439-92-1	Lead[e]	1.1 E-02	7.0 E-03
7439-96-5	Manganese[e,h]	1.2 E-04	7.8 E-05
75-09-2	Methylene chloride[e,h]	3.1 E-07	2.0 E-07

Table 15.5.3-2 (cont.)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
91-20-3	Naphthalene[e,h]	3.9 E-07	2.5 E-07
85-01-8	Phenanthrene[e,h]	1.5 E-08	9.6 E-09
108-95-2	Phenol[e]	2.5 E-06	1.6 E-06
123-38-6	Propionaldehyde[e]	1.1 E-06	6.9 E-07
129-00-0	Pyrene[d,h]	7.0 E-09	4.5 E-09
100-42-5	Styrene[e]	1.9 E-07	1.3 E-07
108-88-3	Toluene[e,h]	2.1 E-07	1.3 E-07
7440-66-6	Zinc[f,h]	2.4 E-05	1.6 E-05

[a] Factors represent uncontrolled emissions. References 1, 2, and 5.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 1.55 pounds per item. Reference 1.
[d] Hazardous air pollutant under CAA Section 112(b).
[e] Reportable chemical under EPCRA Section 313 and a hazardous air pollutant under CAA Section 112(b).
[f] Reportable chemical under EPCRA Section 313.
[g] EMISSION FACTOR RATING A.
[h] EMISSION FACTOR RATING B.
[i] EMISSION FACTOR RATING D.

References For Section 15.5.3

1. *Report No. 5 for the Exploding Ordnance Emission Study Phase II,* Military Environmental Technology Demonstration Center, U.S. Army Aberdeen Test Center, Aberdeen Proving Ground, MD, January 2005.

2. *Detailed Test Plan No. 5 for the Exploding Ordnance Emission Study, Phase II,* Military Environmental Technology Demonstration Center, U.S. Army Aberdeen Test Center, Aberdeen Proving Ground, MD, May 2002.

3. *Hazard Classification of United States Military Explosives and Munitions,* U.S. Army Defense Ammunition Center, Logistics Review and Technical Assistance Office, McAlester, OK, Revision 11, February 2001.

4. *Background Document, Report on Revisions to 5th Edition AP-42 Chapter 15 - Ordnance Detonation, Emission Factors Developed Based on Exploding Ordnance Emission Study Phase II Series 5 Testing Conducted at Aberdeen Proving Ground, Maryland,* MACTEC Federal Programs, Inc., Research Triangle Park, NC, January 2007.

5. Supporting information including Excel spreadsheets, analytical results, field notes, and case summaries supplied upon request by the Applied Science Test Team - Chemistry Unit, U.S. Army Aberdeen Test Center, Aberdeen Proving Ground, MD, October 2004 and March 2005.

15.5.4 G911, MK3A2 Offensive Hand Grenade

15.5.4.1 Ordnance Description[1,2]

The MK3A2 Offensive Hand Grenade (DODIC G911) is a concussion grenade that is designed to produce casualties during close combat. This grenade is also used for blast effect and for demolition tasks. This ammunition is used during combat and on firing ranges during training.

The MK3A2 Offensive Hand Grenade consists of a cylindrical body made of pressed fiber. An M206A1 or M206A2 pyrotechnic delay-detonating fuse is used to function the grenade 4 to 5 seconds after a safety lever is released. The body of the fuse contains a primer and a pyrotechnic delay. Attached to the body of the fuse are a striker, striker spring, safety lever, safety pin and pull ring, safety clip, and a detonator assembly.

15.5.4.2 Emissions And Controls[1-8]

Carbon dioxide (CO_2) is the primary pollutant emitted from the use of the MK3A2 Offensive Hand Grenade. Criteria pollutants, hazardous air pollutants as defined by the *Clean Air Act* (CAA), and toxic chemicals (i.e. those chemicals regulated under Section 313 of the *Emergency Planning and Community Right to Know Act* [EPCRA]) are emitted at low levels. As this ordnance is typically used in the field, there are no controls associated with its use.

Table 15.5.4-1 presents emission factors for CO_2, criteria pollutants, methane, and total suspended particulate (TSP). Table 15.5.4-2 presents emission factors for hazardous air pollutants and toxic chemicals. In both tables, the emission factors are presented in units of pounds of emissions per item (lb per item) and in units of pounds of emissions per pound net explosive weight contained in the item (lb per lb NEW).

TABLE 15.5.4-1 EMISSION FACTORS FOR THE USE OF DODIC G911, MK3A2 OFFENSIVE HAND GRENADE - CARBON DIOXIDE, CRITERIA POLLUTANTS, METHANE, AND TOTAL SUSPENDED PARTICULATE[a]

EMISSION FACTOR RATING: C (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
124-38-9	CO_2[f]	6.2 E-01	1.3
630-08-0	Carbon monoxide (CO)[g]	1.4 E-02	2.8 E-02
7439-92-1	Lead (Pb)	3.3 E-04	6.7 E-04
74-82-8	Methane[g]	2.9 E-04	5.9 E-04
--	Oxides of nitrogen (NO_x)[f]	7.4 E-03	1.5 E-02
--	PM-2.5[d,g]	2.0 E-02	4.0 E-02
--	PM-10[e]	3.5 E-02	7.0 E-02
7446-09-5	Sulfur dioxide (SO_2)	4.9 E-05	9.8 E-05
12789-66-1	TSP	3.9 E-02	7.9 E-02

[a] Factors represent uncontrolled emissions. References 1-4 and 8.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 4.94 E-01 pounds per item. Reference 8.
[d] PM-2.5 = particulate matter with an aerodynamic diameter equal to or less than 2.5 micrometers (µm).
[e] PM-10 = particulate matter with an aerodynamic diameter equal to or less than 10 µm.
[f] EMISSION FACTOR RATING A.
[g] EMISSION FACTOR RATING B.

Table 15.5.4-2 EMISSION FACTORS FOR THE USE OF DODIC G911, MK3A2 OFFENSIVE HAND GRENADE - HAZARDOUS AIR POLLUTANTS AND TOXIC CHEMICALS[a]

EMISSION FACTOR RATING: C (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
83-32-9	Acenaphthene[d,h]	8.7 E-08	1.8 E-07
208-96-8	Acenaphthylene[d,h]	1.1 E-06	2.3 E-06
75-07-0	Acetaldehyde[e,h]	5.8 E-05	1.2 E-04
75-05-8	Acetonitrile[e,h]	2.1 E-05	4.2 E-05
107-02-8	Acrolein[e]	4.7 E-06	9.5 E-06
107-13-1	Acrylonitrile[e,h]	3.9 E-06	7.8 E-06
7429-90-5	Aluminum[f,h]	3.1 E-04	6.2 E-04
120-12-7	Anthracene[e,h]	1.5 E-07	3.0 E-07
7440-39-3	Barium[f]	3.3 E-04	6.6 E-04
71-43-2	Benzene[e,h]	3.7 E-05	7.5 E-05
56-55-3	Benzo[a]anthracene[e]	1.1 E-07	2.2 E-07
205-99-2	Benzo[b]fluoranthene[e]	8.0 E-08	1.6 E-07
207-08-9	Benzo[k]fluoranthene[e]	6.6 E-08	1.3 E-07
191-24-2	Benzo[g,h,i]perylene[e]	8.8 E-08	1.8 E-07
50-32-8	Benzo[a]pyrene[e]	8.1 E-08	1.6 E-07
192-97-2	Benzo[e]pyrene[d]	1.2 E-07	2.4 E-07
85-68-7	Butylbenzylphthalate[d,g]	1.7 E-06	3.4 E-06
123-72-8	Butyraldehyde[d]	5.2 E-06	1.0 E-05
7440-43-9	Cadmium[e]	1.8 E-05	3.6 E-05
75-15-0	Carbon disulfide[e]	1.7 E-06	3.4 E-06
74-87-3	Chloromethane[e,h]	1.5 E-07	3.0 E-07
7440-47-3	Chromium[e,h]	2.8 E-05	5.6 E-05
18540-29-9	Hexavalent chromium[e,i]	3.1 E-06	6.3 E-06
218-01-9	Chrysene[e]	1.3 E-07	2.6 E-07
7440-50-8	Copper[f,h]	2.3 E-04	4.6 E-04
4170-30-3	Crotonaldehyde[f]	5.2 E-06	1.0 E-05
53-70-3	Dibenz[a,h]anthracene[e]	3.0 E-08	6.1 E-08
84-74-2	Dibutyl phthalate[e,g]	3.2 E-06	6.4 E-06
107-06-2	1,2-Dichloroethane[e]	3.7 E-07	7.4 E-07
121-14-2	2,4-Dinitrotoluene[e]	1.4 E-05	2.8 E-05

Table 15.5.4-2 (cont.)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
--	Total dioxin/furan compounds[e]	2.9 E-10	5.9 E-10
100-41-4	Ethylbenzene[e,h]	8.5 E-07	1.7 E-06
74-85-1	Ethylene[f,h]	3.2 E-04	6.4 E-04
117-81-7	bis(2-Ethylhexyl)phthalate[f,g]	6.5 E-06	1.3 E-05
206-44-0	Fluoranthene[e,h]	3.2 E-07	6.4 E-07
86-73-7	Fluorene[d,h]	2.0 E-07	4.0 E-07
50-00-0	Formaldehyde[e]	4.3 E-05	8.6 E-05
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin[e]	2.1 E-11	4.2 E-11
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran[e]	2.8 E-12	5.6 E-12
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin[e]	5.4 E-13	1.1 E-12
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin[e]	8.5 E-13	1.7 E-12
74-90-8	Hydrogen cyanide[e]	2.6 E-04	5.2 E-04
193-39-5	Indeno[1,2,3-cd]pyrene[e]	4.1 E-08	8.4 E-08
7439-92-1	Lead[e]	3.3 E-04	6.7 E-04
7439-96-5	Manganese[e,h]	6.2 E-05	1.3 E-04
75-09-2	Methylene chloride[e,h]	9.4 E-07	1.9 E-06
91-20-3	Naphthalene[e,h]	2.2 E-06	4.4 E-06
7440-02-0	Nickel[e,h]	1.5 E-05	3.0 E-05
7697-37-2	Nitric acid[f,h]	1.1 E-04	2.2 E-04
3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin[e]	2.6 E-10	5.2 E-10
39001-02-0	1,2,3,4,6,7,8,9-Octachlorodibenzofuran[e]	8.7 E-12	1.8 E-11
85-01-8	Phenanthrene[e,h]	7.1 E-07	1.4 E-06
108-95-2	Phenol[e]	1.7 E-06	3.5 E-06
123-38-6	Propionaldehyde[e]	8.0 E-06	1.6 E-05
115-07-1	Propylene[f,h]	7.9 E-05	1.6 E-04
129-00-0	Pyrene[d,h]	4.8 E-07	9.6 E-07
7664-93-9	Sulfuric acid[f]	3.7 E-05	7.5 E-05
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran[e]	1.3 E-12	2.6 E-12
108-88-3	Toluene[e,h]	8.4 E-06	1.7 E-05
95-63-6	1,2,4-Trimethylbenzene[f,h]	4.4 E-07	8.9 E-07
7440-62-2	Vanadium[f]	3.9 E-03	8.0 E-03

Table 15.5.4-2 (cont.)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
106-42-3, 108-38-3	m-Xylene, p-Xylene[e,h]	7.7 E-07	1.6 E-06
95-47-6	o-Xylene[e,h]	2.3 E-07	4.7 E-07
7440-66-6	Zinc[f,h]	6.6 E-03	1.3 E-02

[a] Factors represent uncontrolled emissions. References 1-4 and 8.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 4.94 E-01 pounds per item. Reference 8.
[d] Hazardous air pollutant under CAA Section 112(b).
[e] Reportable chemical under EPCRA Section 313 and a hazardous air pollutant under CAA Section 112(b).
[f] Reportable chemical under EPCRA Section 313.
[g] EMISSION FACTOR RATING A.
[h] EMISSION FACTOR RATING B.
[i] EMISSION FACTOR RATING D.

References for Section 15.5.4

1. *Report No. 2 for the Exploding Ordnance Emission Study Phase II,* Military Environmental Technology Demonstration Center, U.S. Army Aberdeen Test Center, Aberdeen Proving Ground, MD, December 2003.

2. *Report No. 6 for the Exploding Ordnance Emission Study Phase II,* Military Environmental Technology Demonstration Center, U.S. Army Aberdeen Test Center, Aberdeen Proving Ground, MD, March 2005.

3. *Detailed Test Plan No. 2 for the Exploding Ordnance Emission Study Phase II,* Military Environmental Technology Demonstration Center, U.S. Army Aberdeen Test Center, Aberdeen Proving Ground, MD, March 2001.

4. *Detailed Test Plan No. 6 for the Exploding Ordnance Emission Study Phase II,* Military Environmental Technology Demonstration Center, U.S. Army Aberdeen Test Center, Aberdeen Proving Ground, MD, November 2002.

5. *Hazard Classification of United States Military Explosives and Munitions,* U.S. Army Defense Ammunition Center, Logistics Review and Technical Assistance Office, McAlester, OK, Revision 11, February 2001.

6. *Background Document, Report on Revisions to 5th Edition AP-42 Chapter 15 - Ordnance Detonation, Emission Factors Developed Based on Exploding Ordnance Emission Study Phase II Series 2 Testing Conducted at Aberdeen Proving Ground, Maryland,* MACTEC Federal Programs, Inc., Research Triangle Park, NC, July 2006.

7. *Background Document, Report on Revisions to 5th Edition AP-42 Chapter 15 - Ordnance Detonation, Emission Factors Developed Based on Exploding Ordnance Emission Study Phase II Series 6 Testing Conducted at Aberdeen Proving Ground, Maryland,* MACTEC Federal Programs, Inc., Research Triangle Park, NC, September 2006.

8. Supporting information including Excel spreadsheets, analytical results, field notes, and case summaries supplied upon request by the Applied Science Test Team – Chemistry Unit, U.S. Army Aberdeen Test Center, Aberdeen Proving Ground, MD, October 2004, April 2005, and May 2005.

15.5.5 G930, AN-M8 Hexachloroethane (HC) Smoke Hand Grenade

15.5.5.1 Ordnance Description[1,2]

The AN-M8 Hexachloroethane (HC) Smoke Hand Grenade (DODIC G930) is a burning-type grenade used to generate smoke for screening the activities of small units. It is also used for ground-to-air or ground-to-ground signaling. When used, the grenade will emit a dense white smoke for 105 to 150 seconds. This ammunition is used during combat and on firing ranges during training.

The AN-M8 HC Smoke Hand Grenade consists of a 5.75 inch long by 2.5 inch diameter cylindrical body made of sheet metal that is filled with HC smoke mixture. An M201A1 pyrotechnic delay-igniting fuse is used to function the grenade after a safety lever is released. The body of the fuse contains a primer, first fire mixture, pyrotechnic delay column, and ignition mixture. Attached to the body of the grenade are a striker, striker spring, safety lever, safety pin, and pull ring.

15.5.5.2 Emissions And Controls[1-4]

Particulate matter is the primary pollutant emitted from the use of the AN-M8 HC Smoke Hand Grenade. Other criteria pollutants, hazardous air pollutants as defined by the *Clean Air Act* (CAA), and toxic chemicals (i.e. those chemicals regulated under Section 313 of the *Emergency Planning and Community Right to Know Act* [EPCRA]) are emitted at low levels. As this ordnance is typically used in the field, there are no controls associated with its use.

Table 15.5.5-1 presents emission factors for carbon dioxide (CO_2), criteria pollutants, total nonmethane hydrocarbons (TNMHC), and total suspended particulate (TSP). Table 15.5.5-2 presents emission factors for hazardous air pollutants and toxic chemicals. In both tables, the emission factors are presented in units of pounds of emissions per item (lb per item) and in units of pounds of emissions per pound net explosive weight contained in the item (lb per lb NEW).

Table 15.5.5-1 EMISSION FACTORS FOR THE USE OF DODIC G930, AN-M8 HC SMOKE HAND GRENADE – CARBON DIOXIDE, CRITERIA POLLUTANTS, TOTAL NONMETHANE HYDROCARBONS, AND TOTAL SUSPENDED PARTICULATE[a]

EMISSION FACTOR RATING: C (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
124-38-9	CO_2[f]	3.3 E-02	3.0 E-02
630-08-0	Carbon monoxide (CO)[f]	4.6 E-02	4.2 E-02
7439-92-1	Lead (Pb)	4.7 E-04	4.2 E-04
--	Oxides of nitrogen (NO_x)[f]	1.0 E-03	9.1 E-04
--	PM-2.5[d]	1.1 E-01	1.0 E-01
--	PM-10[e]	6.8 E-01	6.2 E-01
7446-09-5	Sulfur dioxide (SO_2)	1.2 E-04	1.1 E-04
--	TNMHC	6.3 E-04	5.7 E-04
12789-66-1	TSP[f]	4.7 E-01	4.3 E-01

[a] Factors represent uncontrolled emissions. References 1-4.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 1.10 pounds per item. Reference 5.
[d] PM-2.5 = particulate matter with an aerodynamic diameter equal to or less than 2.5 micrometers (μm).
[e] PM-10 = particulate matter with an aerodynamic diameter equal to or less than 10 μm.
[f] EMISSION FACTOR RATING B.

Table 15.5.5-2 EMISSION FACTORS FOR THE USE OF DODIC G930, AN-M8 HC SMOKE HAND GRENADE – HAZARDOUS AIR POLLUTANTS AND TOXIC CHEMICALS[a]

EMISSION FACTOR RATING: C (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
75-05-8	Acetonitrile[d]	1.2 E-05	1.1 E-05
98-86-2	Acetophenone[d]	1.0 E-06	9.2 E-07
107-02-8	Acrolein[d]	6.8 E-06	6.2 E-06
107-13-1	Acrylonitrile[d]	3.2 E-06	2.9 E-06
107-05-1	Allyl chloride[d]	2.7 E-06	2.5 E-06
7429-90-5	Aluminum[e]	3.8 E-03	3.4 E-03
62-53-3	Aniline[d]	2.9 E-06	2.6 E-06
7440-36-0	Antimony[d,h]	5.4 E-07	4.9 E-07
7440-39-3	Barium[e]	1.8 E-05	1.6 E-05
71-43-2	Benzene[d]	1.3 E-05	1.2 E-05
29082-74-4	Benzene, pentachloro(trichloroethenyl)-[e,h]	2.3 E-06	2.0 E-06
100-44-7	Benzyl chloride[d]	3.2 E-06	2.9 E-06
106-99-0	1,3-Butadiene[d]	1.6 E-06	1.5 E-06
7440-43-9	Cadmium[d]	5.8 E-06	5.3 E-06
56-23-5	Carbon tetrachloride[d,h]	1.5 E-03	1.3 E-03
7782-50-5	Chlorine[d]	9.0 E-03	8.2 E-03
108-90-7	Chlorobenzene[d,g]	2.7 E-06	2.4 E-06
67-66-3	Chloroform[d]	3.7 E-05	3.4 E-05
74-87-3	Chloromethane[d]	9.3 E-06	8.4 E-06
7440-47-3	Chromium[d]	3.8 E-06	3.4 E-06
7440-50-8	Copper[e,g]	1.4 E-06	1.3 E-06
4170-30-3	Crotonaldehyde[e]	2.3 E-07	2.0 E-07
--	Total dioxin/furan compounds[d]	1.4 E-07	1.3 E-07
74-85-1	Ethylene[e]	1.4 E-05	1.3 E-05
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin[d,h]	1.1 E-10	9.6 E-11
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran[d,h]	7.1 E-09	6.5 E-09
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran[d,h]	1.5 E-09	1.4 E-09
118-74-1	Hexachlorobenzene[d,h]	2.4 E-04	2.2 E-04
87-68-3	Hexachlorobutadiene[d]	5.9 E-05	5.4 E-05
77-47-4	Hexachlorocyclopentadiene[d,h]	3.8 E-05	3.4 E-05

Table 15.5.5-2 (cont.)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran[d,h]	1.5 E-09	1.4 E-09
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran[d,h]	6.8 E-10	6.2 E-10
72918-21-9	1,2,3,7,8,9-Hexachlorodibenzofuran[d,h]	1.3 E-10	1.2 E-10
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran[d,h]	4.5 E-10	4.1 E-10
67-72-1	Hexachloroethane[d,h]	1.1 E-05	9.8 E-06
7647-01-0	Hydrochloric acid[d]	6.9 E-03	6.3 E-03
7439-92-1	Lead[d]	4.7 E-04	4.2 E-04
7439-96-5	Manganese[d]	5.9 E-05	5.3 E-05
75-09-2	Methylene chloride[d,h]	1.3 E-05	1.2 E-05
7440-02-0	Nickel[d]	2.1 E-06	1.9 E-06
55-63-0	Nitroglycerin[e,h]	1.4 E-06	1.3 E-06
3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin[d]	3.0 E-10	2.8 E-10
39001-02-0	1,2,3,4,6,7,8,9-Octachlorodibenzofuran[d,h]	1.3 E-07	1.1 E-07
608-93-5	Pentachlorobenzene[e,h]	1.7 E-06	1.6 E-06
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran[d,h]	2.2 E-10	2.0 E-10
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran[d,h]	3.7 E-10	3.4 E-10
108-95-2	Phenol[d]	2.1 E-07	1.9 E-07
7723-14-0	Phosphorus[f]	8.0 E-06	7.3 E-06
123-38-6	Propionaldehyde[d]	1.3 E-07	1.2 E-07
7440-22-4	Silver[e]	3.3 E-07	3.0 E-07
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran[d,h]	8.8 E-11	8.0 E-11
127-18-4	Tetrachloroethylene[d]	1.4 E-03	1.3 E-03
7440-28-0	Thallium[e]	8.5 E-07	7.8 E-07
108-88-3	Toluene[d]	3.8 E-06	3.5 E-06
79-01-6	Trichloroethylene[d]	7.9 E-06	7.2 E-06
88-06-2	2,4,6-Trichlorophenol[d,h]	1.0 E-06	9.2 E-07
75-01-4	Vinyl chloride[d,g]	2.7 E-06	2.5 E-06
7440-66-6	Zinc[e]	1.9 E-01	1.7 E-01

Table 15.5.5-2 (cont.)

[a] Factors represent uncontrolled emissions. References 1-4.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 1.10 pounds per item. Reference 5.
[d] Reportable chemical under EPCRA Section 313 and a hazardous air pollutant under CAA Section 112(b).
[e] Reportable chemical under EPCRA Section 313.
[f] Hazardous air pollutant under CAA Section 112(b).
[g] EMISSION FACTOR RATING B.
[h] EMISSION FACTOR RATING D.

References for Section 15.5.5

1. *Sampling Results for AEC Phase V Emission Characterization of Exploding Ordnance and Smoke/Pyrotechnics, Revision 1*, URS Group, Inc., Oak Ridge, TN, February 2007.

2. *Detailed Test Plan for Phase V Emission Characterization of Exploding Ordnance and Smoke/Pyrotechnics*, West Desert Test Center, U.S. Army Dugway Proving Ground, UT, October 2003.

3. Supporting information including Excel spreadsheets supplied upon request by the U.S. Army Dugway Proving Ground test support contractor, URS Group, Inc., Oak Ridge, TN, January 2006 and February 2007.

4. *Background Document, Report on Revisions to 5th Edition AP-42 Chapter 15 - Ordnance Detonation, Emission Factors Developed Based on Phase V-A Testing Conducted at Dugway Proving Ground, Utah*, MACTEC Federal Programs, Inc., Research Triangle Park, NC, November 2007.

5. *Munitions Items Disposition Action System (MIDAS)* website, https://midas.dac.army.mil/, U.S. Army Defense Ammunition Center, McAlester, OK, November 2006.

This page left blank intentionally.

15.5.6 G940, M18 Green Smoke Hand Grenade

15.5.6.1 Ordnance Description[1,2]

The M18 Green Smoke Hand Grenade (DODIC G940) is a colored-smoke hand grenade used for ground-to-air or ground-to-ground signaling. When used, the grenade will emit a green smoke for 50 to 90 seconds. This ammunition is used during combat and on firing ranges during training.

The M18 Green Smoke Hand Grenade consists of a 5.75 inch long by 2.5 inch diameter cylindrical body made of sheet metal. An M201A1 pyrotechnic delay-detonating fuse is used to function the grenade 0.7 to 2 seconds after a safety lever is released. The body of the fuse contains a primer, first fire mixture, pyrotechnic delay column, and ignition mixture. Attached to the body of the grenade are a striker, striker spring, safety lever, safety pin, and pull ring.

15.5.6.2 Emissions And Controls[2,3,4]

Particulate matter and carbon dioxide (CO_2) are the primary pollutants emitted from the use of the M18 Green Smoke Hand Grenade. Other criteria pollutants, hazardous air pollutants as defined by the *Clean Air Act* (CAA), and toxic chemicals (i.e. those chemicals regulated under Section 313 of the *Emergency Planning and Community Right to Know Act* [EPCRA]) are emitted at low levels. As this ordnance is typically used in the field, there are no controls associated with its use.

Table 15.5.6-1 presents emission factors for CO_2, criteria pollutants, total nonmethane hydrocarbons (TNMHC), and total suspended particulate (TSP). Table 15.5.6-2 presents emission factors for hazardous air pollutants and toxic chemicals. In both tables, the emission factors are presented in units of pounds of emissions per item (lb per item) and in units of pounds of emissions per pound net explosive weight contained in the item (lb per lb NEW).

Table 15.5.6-1 EMISSION FACTORS FOR THE USE OF DODIC G940, M18 GREEN SMOKE HAND GRENADE – CARBON DIOXIDE, CRITERIA POLLUTANTS, TOTAL NONMETHANE HYDROCARBONS, AND TOTAL SUSPENDED PARTICULATE[a]

EMISSION FACTOR RATING: C (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
124-38-9	CO_2[f]	8.4 E-02	1.2 E-01
630-08-0	Carbon monoxide (CO)[f]	1.2 E-02	1.6 E-02
7439-92-1	Lead (Pb)	3.4 E-05	4.7 E-05
10102-44-0	Nitrogen dioxide (NO_2)	1.7 E-05	2.4 E-05
10102-43-9	Nitric oxide (NO)[f]	6.4 E-05	8.9 E-05
--	Oxides of nitrogen (NO_x)[f]	1.2 E-04	1.6 E-04
--	PM-2.5[d]	1.0 E-01	1.4 E-01
--	PM-10[e]	1.3 E-01	1.8 E-01
7446-09-5	Sulfur dioxide (SO_2)[g]	1.6 E-04	2.3 E-04
--	TNMHC	2.1 E-03	2.9 E-03
12789-66-1	TSP[f]	1.3 E-01	1.7 E-01

[a] Factors represent uncontrolled emissions. References 2, 3, and 4.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 7.20 E-01 pounds per item. Reference 2.
[d] PM-2.5 = particulate matter with an aerodynamic diameter equal to or less than 2.5 micrometers (μm).
[e] PM-10 = particulate matter with an aerodynamic diameter equal to or less than 10 μm.
[f] EMISSION FACTOR RATING B.
[g] EMISSION FACTOR RATING D.

Table 15.5.6-2 EMISSION FACTORS FOR THE USE OF DODIC G940,
M18 GREEN SMOKE HAND GRENADE –
HAZARDOUS AIR POLLUTANTS AND TOXIC CHEMICALS[a]

EMISSION FACTOR RATING: D (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
75-07-0	Acetaldehyde[d,g]	3.4 E-04	4.7 E-04
75-05-8	Acetonitrile[d,g]	6.9 E-06	9.6 E-06
98-86-2	Acetophenone[d,g]	1.1 E-05	1.6 E-05
107-02-8	Acrolein[d,g]	8.4 E-05	1.2 E-04
107-13-1	Acrylonitrile[d]	5.1 E-07	7.0 E-07
7429-90-5	Aluminum[e,g]	9.0 E-05	1.3 E-04
7440-39-3	Barium[d,g]	1.8 E-06	2.4 E-06
71-43-2	Benzene[d,g]	3.3 E-04	4.6 E-04
7440-41-7	Beryllium[d]	1.1E-08	1.5 E-08
106-99-0	1,3-Butadiene[d,f]	1.8 E-05	2.6 E-05
123-72-8	Butyraldehyde[e,g]	5.0 E-06	7.0 E-06
75-15-0	Carbon disulfide[d,f]	4.1 E-05	5.8 E-05
56-23-5	Carbon tetrachloride[d]	8.6 E-08	1.2 E-07
7782-50-5	Chlorine[d]	1.6 E-06	2.3 E-06
108-90-7	Chlorobenzene[d,f]	6.7 E-06	9.3 E-06
75-00-3	Chloroethane[d,g]	1.9 E-07	2.7 E-07
67-66-3	Chloroform[d,f]	9.7 E-06	1.4 E-05
7440-47-3	Chromium[d]	1.5 E-05	2.0 E-05
7440-50-8	Copper[e]	4.2 E-07	5.8 E-07
95-50-1	1,2-Dichlorobenzene[e,f]	2.9 E-06	4.0 E-06
541-73-1	1,3-Dichlorobenzene[e,g]	2.0 E-07	2.7 E-07
106-46-7	1,4-Dichlorobenzene[d,g]	4.9 E-07	6.8 E-07
--	Total dioxin/furan compounds[d,g]	5.6 E-10	7.8 E-10
100-41-4	Ethylbenzene[d,g]	6.3 E-06	8.8 E-06
74-85-1	Ethylene[e,g]	7.3 E-05	1.0 E-04
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin[d]	3.8 E-11	5.3 E-11
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	4.4 E-11	6.1 E-11
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran[d]	9.8 E-12	1.4 E-11
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin[d]	1.6 E-12	2.2 E-12
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin[d]	2.2 E-12	3.1 E-12

Table 15.5.6-2 (cont.)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin[d]	3.2 E-12	4.4 E-12
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran[d]	1.5 E-11	2.1 E-11
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran[d]	7.0 E-12	9.7 E-12
72918-21-9	1,2,3,7,8,9-Hexachlorodibenzofuran[d]	9.5 E-12	1.3 E-11
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran[d]	9.2 E-12	1.3 E-11
7647-01-0	Hydrochloric acid[d,g]	8.0 E-04	1.1 E-03
67-63-0	Isopropyl alcohol[e,g]	1.3 E-05	1.7 E-05
7439-92-1	Lead[d,g]	3.4 E-05	4.7 E-05
7439-96-5	Manganese[d,g]	5.3 E-06	7.3 E-06
7439-97-6	Mercury[d,g]	4.4 E-09	6.1 E-09
75-09-2	Methylene chloride[d]	4.1 E-05	5.7 E-05
7440-02-0	Nickel[d]	7.3 E-06	1.0 E-05
3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin[d,f]	2.3 E-10	3.2 E-10
39001-02-0	1,2,3,4,6,7,8,9-Octachlorodibenzofuran[d]	5.5 E-11	7.6 E-11
40321-76-4	1,2,3,7,8-Pentachlorodibenzo-p-dioxin[d]	2.7 E-12	3.8 E-12
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran[d]	3.4 E-11	4.8 E-11
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran[d]	6.1 E-12	8.4 E-12
123-38-6	Propionaldehyde[d,g]	4.6 E-05	6.3 E-05
115-07-1	Propylene[e,f]	5.9 E-05	8.2 E-05
7782-49-2	Selenium[d]	1.4 E-07	2.0 E-07
7440-22-4	Silver[e]	1.0 E-07	1.4 E-07
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin[d]	3.2 E-12	4.4 E-12
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran[d]	8.5 E-11	1.2 E-10
127-18-4	Tetrachloroethylene[d]	5.1 E-07	7.1 E-07
108-88-3	Toluene[d,g]	2.9 E-04	4.0 E-04
79-01-6	Trichloroethylene[d,g]	1.0 E-05	1.4 E-05
75-69-4	Trichloromonofluoromethane[e]	1.5 E-08	2.0 E-08
75-01-4	Vinyl chloride[d,g]	6.7 E-07	9.3 E-07
75-35-4	Vinylidene chloride[d,g]	3.4 E-07	4.7 E-07
106-42-3, 108-38-3	m-Xylene, p-Xylene[d,g]	3.5 E-05	4.8 E-05
95-47-6	o-Xylene[d,g]	3.8 E-06	5.3 E-06
7440-66-6	Zinc[e,g]	9.1 E-07	1.3 E-06

Table 15.5.6-2 (cont.)

[a] Factors represent uncontrolled emissions. References 2, 3, and 4.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 7.20 E-01 pounds per item. Reference 2.
[d] Reportable chemical under EPCRA Section 313 and a hazardous air pollutant under CAA Section 112(b).
[e] Reportable chemical under EPCRA Section 313.
[f] EMISSION FACTOR RATING B.
[g] EMISSION FACTOR RATING C.

References for Section 15.5.6

1. *Army Ammunition Data Sheets for Grenades*, Technical Manual TM 43-0001-29 C1, Headquarters, Department of the Army, Washington, DC, June 1995.

2. *Sampling Results for AEC Phase III Training Ordnance Emission Characterization*, URS Corporation, Oak Ridge, TN, July 2001.

3. Supporting information including Excel spreadsheets supplied upon request by the U.S. Army Dugway Proving Ground test support contractor, URS Corporation, Oak Ridge, TN, January 2005.

4. *Background Document, Report on Revisions to 5th Edition AP-42 Chapter 15 - Ordnance Detonation, Emission Factors Developed Based on Phase III Testing Conducted at Dugway Proving Ground, Utah*, MACTEC Federal Programs, Inc., Research Triangle Park, NC, June 2007.

This page left blank intentionally.

15.5.7 G945, M18 Yellow Smoke Hand Grenade

15.5.7.1 Ordnance Description[1,2]

The M18 Yellow Smoke Hand Grenade (DODIC G945) is a colored-smoke hand grenade used for ground-to-air or ground-to-ground signaling. When used, the grenade will emit a yellow smoke for 50 to 90 seconds. This ammunition is used during combat and on firing ranges during training.

The M18 Yellow Smoke Hand Grenade consists of a 5.75 inch long by 2.5 inch diameter cylindrical body made of sheet metal. An M201A1 pyrotechnic delay-detonating fuse is used to function the grenade 0.7 to 2 seconds after a safety lever is released. The body of the fuse contains a primer, first fire mixture, pyrotechnic delay column, and ignition mixture. Attached to the body of the grenade are a striker, striker spring, safety lever, safety pin, and pull ring.

15.5.7.2 Emissions And Controls[2,3,4]

Carbon dioxide (CO_2) and total suspended particulates (TSP) are the primary pollutants emitted from the use of the M18 Yellow Smoke Hand Grenade. Criteria pollutants, hazardous air pollutants as defined by the *Clean Air Act* (CAA), and toxic chemicals (i.e. those chemicals regulated under Section 313 of the *Emergency Planning and Community Right to Know Act* [EPCRA]) are emitted at low levels. As this ordnance is typically used in the field, there are no controls associated with its use.

Table 15.5.7-1 presents emission factors for CO_2, criteria pollutants, total nonmethane hydrocarbons (TNMHC), and TSP. Table 15.5.7-2 presents emission factors for hazardous air pollutants and toxic chemicals. In both tables, the emission factors are presented in units of pounds of emissions per item (lb per item) and in units of pounds of emissions per pound net explosive weight contained in the item (lb per lb NEW).

Table 15.5.7-1 EMISSION FACTORS FOR THE USE OF DODIC G945, M18 YELLOW SMOKE HAND GRENADE – CARBON DIOXIDE, CRITERIA POLLUTANTS, TOTAL NONMETHANE HYDROCARBONS, AND TOTAL SUSPENDED PARTICULATE[a]

EMISSION FACTOR RATING: B (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
124-38-9	CO_2	7.7 E-02	1.1 E-01
630-08-0	Carbon monoxide (CO)	4.0 E-03	5.5 E-03
7439-92-1	Lead (Pb)[d]	1.5 E-05	2.0 E-05
10102-43-9	Nitric oxide (NO)	8.1 E-05	1.1 E-04
--	Oxides of nitrogen (NO_x)	7.8 E-05	1.1 E-04
7446-09-5	Sulfur dioxide (SO_2)[d]	9.9 E-04	1.4 E-03
--	TNMHC[d]	2.0 E-04	2.8 E-04
12789-66-1	TSP	6.5 E-02	9.0 E-02

[a] Factors represent uncontrolled emissions. References 2, 3, and 4.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 7.20 E-01 pounds per item. Reference 2.
[d] EMISSION FACTOR RATING C.

Table 15.5.7-2 EMISSION FACTORS FOR THE USE OF DODIC G945, M18 YELLOW SMOKE HAND GRENADE – HAZARDOUS AIR POLLUTANTS AND TOXIC CHEMICALS[a]

EMISSION FACTOR RATING: C (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
75-07-0	Acetaldehyde[d]	9.2 E-06	1.3 E-05
75-05-8	Acetonitrile[d]	2.3 E-07	3.1 E-07
107-02-8	Acrolein[d]	2.6 E-06	3.6 E-06
107-13-1	Acrylonitrile[d]	1.1 E-07	1.5 E-07
7429-90-5	Aluminum[e]	4.6 E-05	6.4 E-05
7440-39-3	Barium[d,h]	6.0 E-07	8.3 E-07
71-43-2	Benzene[d]	7.1 E-06	9.9 E-06
7440-41-7	Beryllium[d,h]	1.7 E-08	2.4 E-08
106-99-0	1,3-Butadiene[d,g]	1.0 E-06	1.4 E-06
123-72-8	Butyraldehyde[e]	4.2 E-07	5.8 E-07
7440-43-9	Cadmium[d,h]	7.3 E-09	1.0 E-08
75-15-0	Carbon disulfide[d,g]	4.9 E-04	6.8 E-04
56-23-5	Carbon tetrachloride[d]	2.6 E-06	3.6 E-06
463-58-1	Carbonyl sulfide[e]	3.7 E-06	5.2 E-06
7782-50-5	Chlorine[d]	5.1 E-07	7.1 E-07
108-90-7	Chlorobenzene[d,g]	4.0 E-06	5.6 E-06
75-00-3	Chloroethane[d,g]	4.6 E-07	6.4 E-07
67-66-3	Chloroform[d,g]	2.7 E-05	3.7 E-05
7440-47-3	Chromium[d]	2.5 E-07	3.5 E-07
95-50-1	1,2-Dichlorobenzene[e,g]	5.1 E-06	7.1 E-06
541-73-1	1,3-Dichlorobenzene[e]	3.0 E-06	4.2 E-06
106-46-7	1,4-Dichlorobenzene[d]	6.5 E-07	9.0 E-07
75-71-8	Dichlorodifluoromethane[e]	7.9 E-08	1.1 E-07
75-34-3	1,1-Dichloroethane[d]	2.3 E-07	3.2 E-07
107-06-2	1,2-Dichloroethane[d]	6.4 E-07	8.9 E-07
540-59-0	1,2-Dichloroethene[e]	1.1 E-05	1.5 E-05
--	Total dioxin/furan compounds[d]	4.6 E-09	6.4 E-09
100-41-4	Ethylbenzene[d,h]	3.1 E-07	4.4 E-07
74-85-1	Ethylene[e]	2.2 E-05	3.0 E-05
76-13-1	Freon 113[f]	8.1 E-09	1.1 E-08

Table 15.5.7-2 (cont.)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin[d]	9.1 E-11	1.3 E-10
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	2.4 E-10	3.3 E-10
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran[d]	8.9 E-11	1.2 E-10
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin[d]	1.9 E-11	2.7 E-11
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin[d]	5.0 E-11	7.0 E-11
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin[d]	4.7 E-11	6.5 E-11
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran[d]	3.5 E-10	4.8 E-10
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran[d]	1.8 E-10	2.5 E-10
72918-21-9	1,2,3,7,8,9-Hexachlorodibenzofuran[d]	3.3 E-11	4.6 E-11
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran[d]	1.8 E-10	2.4 E-10
110-54-3	n-Hexane[d]	7.9 E-08	1.1 E-07
7647-01-0	Hydrochloric acid[d]	2.8 E-06	3.8 E-06
67-63-0	Isopropyl alcohol[e]	4.5 E-07	6.2 E-07
7439-92-1	Lead[d]	1.5 E-05	2.0 E-05
7439-96-5	Manganese[d]	1.9 E-07	2.6 E-07
7439-97-6	Mercury[d]	1.3 E-09	1.8 E-09
71-55-6	Methyl chloroform[d]	5.9 E-08	8.2 E-08
75-09-2	Methylene chloride[d]	5.5 E-06	7.7 E-06
3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin[d,g]	1.9 E-10	2.6 E-10
39001-02-0	1,2,3,4,6,7,8,9-Octachlorodibenzofuran[d]	7.0 E-10	9.8 E-10
40321-76-4	1,2,3,7,8-Pentachlorodibenzo-p-dioxin[d]	6.5 E-11	9.1 E-11
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran[d]	5.3 E-10	7.4 E-10
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran[d]	3.5 E-10	4.9 E-10
115-07-1	Propylene[e,g]	5.9 E-06	8.2 E-06
7440-22-4	Silver[e,h]	8.8 E-09	1.2 E-08
100-42-5	Styrene[d,h]	1.7 E-07	2.4 E-07
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin[d]	2.1 E-11	2.9 E-11
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran[d]	1.4 E-09	2.0 E-09
79-34-5	1,1,2,2-Tetrachloroethane[d]	4.4 E-07	6.2 E-07
127-18-4	Tetrachloroethylene[d]	5.5 E-06	7.6 E-06
108-88-3	Toluene[d]	2.1 E-06	2.9 E-06
79-00-5	1,1,2-Trichloroethane[d]	1.2 E-06	1.7 E-06

Table 15.5.7-2 (cont.)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
79-01-6	Trichloroethylene[d]	8.6 E-06	1.2 E-05
75-69-4	Trichloromonofluoromethane[e]	7.3 E-08	1.0 E-07
95-63-6	1,2,4-Trimethylbenzene[e]	8.9 E-07	1.2 E-06
75-01-4	Vinyl chloride[d,g]	5.7 E-06	8.0 E-06
75-35-4	Vinylidene chloride[d]	4.2 E-06	5.8 E-06
106-42-3, 108-38-3	m-Xylene, p-Xylene[d,h]	6.8 E-07	9.4 E-07
95-47-6	o-Xylene[d,h]	2.2 E-07	3.0 E-07
7440-66-6	Zinc[e]	8.6 E-07	1.2 E-06

[a] Factors represent uncontrolled emissions. References 2, 3, and 4.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 7.20 E-01 pounds per item. Reference 2.
[d] Reportable chemical under EPCRA Section 313 and a hazardous air pollutant under CAA Section 112(b).
[e] Reportable chemical under EPCRA Section 313.
[f] Hazardous air pollutant under CAA Section 112(b).
[g] EMISSION FACTOR RATING B.
[h] EMISSION FACTOR RATING D.

References for Section 15.5.7

1. *Army Ammunition Data Sheets for Grenades*, Technical Manual TM 43-0001-29 C1, Headquarters, Department of the Army, Washington, DC, June 1995.

2. *Sampling Results for AEC Phase III Training Ordnance Emission Characterization*, URS Corporation, Oak Ridge, TN, July 2001.

3. Supporting information including Excel spreadsheets supplied upon request by the U.S. Army Dugway Proving Ground test support contractor, URS Corporation, Oak Ridge, TN, January 2005.

4. *Background Document, Report on Revisions to 5th Edition AP-42 Chapter 15 - Ordnance Detonation, Emission Factors Developed Based on Phase III Testing Conducted at Dugway Proving Ground, Utah*, MACTEC Federal Programs, Inc., Research Triangle Park, NC, June 2007.

This page left blank intentionally.

15.5.8 G950, M18 Red Smoke Hand Grenade

15.5.8.1 Ordnance Description[1,2]

The M18 Red Smoke Hand Grenade (DODIC G950) is a colored-smoke hand grenade used for ground-to-air or ground-to-ground signaling. When used, the grenade will emit a red smoke for 50 to 90 seconds. This ammunition is used during combat and on firing ranges during training.

The M18 Red Smoke Hand Grenade consists of a 5.75 inch long by 2.5 inch diameter cylindrical body made of sheet metal. An M201A1 pyrotechnic delay-detonating fuse is used to function the grenade 0.7 to 2 seconds after a safety lever is released. The body of the fuse contains a primer, first fire mixture, pyrotechnic delay column, and ignition mixture. Attached to the body of the grenade are a striker, striker spring, safety lever, safety pin, and pull ring.

15.5.8.2 Emissions And Controls[2,3,5]

Particulate matter and carbon dioxide (CO_2) are the primary pollutants emitted from the use of the M18 Red Smoke Hand Grenade. Other criteria pollutants, hazardous air pollutants as defined by the *Clean Air Act* (CAA), and toxic chemicals (i.e. those chemicals regulated under Section 313 of the *Emergency Planning and Community Right to Know Act* [EPCRA]) are emitted at low levels. As this ordnance is typically used in the field, there are no controls associated with its use.

Table 15.5.8-1 presents emission factors for CO_2, criteria pollutants, total nonmethane hydrocarbons (TNMHC), and total suspended particulate (TSP). Table 15.5.8-2 presents emission factors for hazardous air pollutants and toxic chemicals. In both tables, the emission factors are presented in units of pounds of emissions per item (lb per item) and in units of pounds of emissions per pound net explosive weight contained in the item (lb per lb NEW).

Table 15.5.8-1 EMISSION FACTORS FOR THE USE OF DODIC G950, M18 RED SMOKE HAND GRENADE – CARBON DIOXIDE, CRITERIA POLLUTANTS, TOTAL NONMETHANE HYDROCARBONS, AND TOTAL SUSPENDED PARTICULATE[a]

EMISSION FACTOR RATING: B (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
124-38-9	CO_2	7.7 E-02	1.1 E-01
630-08-0	Carbon monoxide (CO)	5.8 E-03	8.0 E-03
7439-92-1	Lead (Pb)[f]	1.9 E-05	2.6 E-05
10102-43-9	Nitric oxide (NO)	3.0 E-04	4.1 E-04
--	Oxides of nitrogen (NO_x)	4.2 E-04	5.9 E-04
--	PM-2.5[d,f]	1.2 E-01	1.7 E-01
--	PM-10[e,f]	1.4 E-01	2.0 E-01
7446-09-5	Sulfur dioxide (SO_2)[f]	4.3 E-04	6.0 E-04
--	TNMHC[f]	5.1 E-04	7.0 E-04
12789-66-1	TSP	1.4 E-01	2.0 E-01

[a] Factors represent uncontrolled emissions. References 2, 3, and 5.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 7.20 E-01 pounds per item. Reference 2.
[d] PM-2.5 = particulate matter with an aerodynamic diameter equal to or less than 2.5 micrometers (μm).
[e] PM-10 = particulate matter with an aerodynamic diameter equal to or less than 10 μm.
[f] EMISSION FACTOR RATING C.

Table 15.5.8-2 EMISSION FACTORS FOR THE USE OF DODIC G950, M18 RED SMOKE HAND GRENADE – HAZARDOUS AIR POLLUTANTS AND TOXIC CHEMICALS[a]

EMISSION FACTOR RATING: C (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
75-07-0	Acetaldehyde[d]	4.6 E-05	6.3 E-05
75-05-8	Acetonitrile[d]	2.9 E-06	4.1 E-06
107-02-8	Acrolein[d,h]	2.6 E-05	3.6 E-05
107-13-1	Acrylonitrile[d]	9.7 E-07	1.4 E-06
71-43-2	Benzene[d]	1.7 E-05	2.3 E-05
7440-41-7	Beryllium[d,h]	4.1 E-08	5.7 E-08
106-99-0	1,3-Butadiene[d,g]	7.8 E-08	1.1 E-07
123-72-8	Butanal[e]	1.3 E-06	1.9 E-06
71-36-3	n-Butyl alcohol[e]	8.2 E-07	1.1 E-06
75-15-0	Carbon disulfide[d]	3.6 E-04	5.0 E-04
56-23-5	Carbon tetrachloride[d]	5.3 E-07	7.3 E-07
463-58-1	Carbonyl sulfide[e,g]	3.4 E-06	4.7 E-06
7782-50-5	Chlorine[d]	2.5 E-07	3.5 E-07
108-90-7	Chlorobenzene[d,g]	1.3 E-06	1.8 E-06
75-00-3	Chloroethane[d,g]	1.5 E-07	2.1 E-07
67-66-3	Chloroform[d,g]	1.3 E-05	1.8 E-05
7440-47-3	Chromium[d]	3.9 E-07	5.5 E-07
7440-50-8	Copper[e]	9.7 E-08	1.4 E-07
95-50-1	1,2-Dichlorobenzene[e,g]	1.2 E-06	1.6 E-06
541-73-1	1,3-Dichlorobenzene[e]	1.1 E-07	1.6 E-07
106-46-7	1,4-Dichlorobenzene[d]	8.1 E-08	1.1 E-07
75-71-8	Dichlorodifluoromethane[e,h]	1.6 E-07	2.2 E-07
540-59-0	1,2-Dichloroethene[e]	4.8 E-07	6.7 E-07
--	Total dioxin/furan compounds[d]	6.6 E-10	9.1 E-10
100-41-4	Ethylbenzene[d]	9.6 E-07	1.3 E-06
74-85-1	Ethylene[e]	5.8 E-05	8.1 E-05
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin[d]	3.4 E-11	4.7 E-11
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran[d,h]	6.3 E-11	8.8 E-11
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran[d]	1.6 E-11	2.2 E-11
87-68-3	Hexachlorobutadiene[d]	1.3 E-06	1.7 E-06

Table 15.5.8-2 (cont.)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin[d,h]	1.2 E-12	1.6 E-12
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin[d,h]	1.9 E-12	2.7 E-12
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin[d,h]	2.1 E-12	2.9 E-12
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran[d]	3.8 E-11	5.3 E-11
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran[d]	1.9 E-11	2.7 E-11
72918-21-9	1,2,3,7,8,9-Hexachlorodibenzofuran[d]	5.4 E-12	7.5 E-12
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran[d,h]	2.5 E-11	3.5 E-11
7647-01-0	Hydrochloric acid[d]	6.8 E-05	9.4 E-05
67-63-0	Isopropyl alcohol[e]	1.9 E-07	2.6 E-07
556-61-6	Isothiocyanatomethane[d]	6.3 E-06	8.8 E-06
7439-92-1	Lead[d]	1.9 E-05	2.6 E-05
7439-96-5	Manganese[d,h]	4.0 E-07	5.6 E-07
7439-97-6	Mercury[d,h]	1.9 E-07	2.6 E-07
75-09-2	Methylene chloride[d]	2.4 E-06	3.3 E-06
108-10-1	Methyl isobutyl ketone[d]	9.8 E-07	1.4 E-06
3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin[d,g]	1.6 E-10	2.2 E-10
39001-02-0	1,2,3,4,6,7,8,9-Octachlorodibenzofuran[d]	2.0 E-10	2.8 E-10
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran[d]	3.2 E-11	4.4 E-11
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran[d]	1.7 E-11	2.4 E-11
7723-14-0	Phosphorus[f]	4.8 E-07	6.6 E-07
115-07-1	Propylene[e,g]	1.5 E-05	2.1 E-05
7440-22-4	Silver[e,h]	1.1 E-08	1.5 E-08
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran[d]	4.2 E-11	5.9 E-11
127-18-4	Tetrachloroethylene[d]	6.4 E-07	8.8 E-07
108-88-3	Toluene[d]	1.7 E-06	2.4 E-06
120-82-1	1,2,4-Trichlorobenzene[d]	3.6 E-08	4.9 E-08
79-01-6	Trichloroethylene[d]	4.4 E-07	6.1 E-07
75-01-4	Vinyl chloride[d,g]	2.1 E-06	2.8 E-06
75-35-4	Vinylidene chloride[d]	4.0 E-07	5.6 E-07
106-42-3, 108-38-3	m-Xylene, p-Xylene[d]	4.0 E-06	5.5 E-06
95-47-6	o-Xylene[d]	3.7 E-07	5.1 E-07
7440-66-6	Zinc[e,h]	9.0 E-06	1.2 E-05

Table 15.5.8-2 (cont.)

[a] Factors represent uncontrolled emissions. References 2, 3, and 5.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 7.20 E-01 pounds per item. Reference 2.
[d] Reportable chemical under EPCRA Section 313 and a hazardous air pollutant under CAA Section 112(b).
[e] Reportable chemical under EPCRA Section 313.
[f] Hazardous air pollutant under CAA Section 112(b).
[g] EMISSION FACTOR RATING B.
[h] EMISSION FACTOR RATING D.

References for Section 15.5.8

1. *Army Ammunition Data Sheets for Grenades*, Technical Manual TM 43-0001-29 C1, Headquarters, Department of the Army, Washington, DC, June 1995.

2. *Sampling Results for AEC Phase III Training Ordnance Emission Characterization*, URS Corporation, Oak Ridge, TN, July 2001.

3. Supporting information including Excel spreadsheets supplied upon request by the U.S. Army Dugway Proving Ground test support contractor, URS Corporation, Oak Ridge, TN, January 2005.

4. *Hazard Classification of United States Military Explosives and Munitions*, U.S. Army Defense Ammunition Center, Logistics Review and Technical Assistance Office, McAlester, OK, Revision 11, February 2001.

5. *Background Document, Report on Revisions to 5th Edition AP-42 Chapter 15 - Ordnance Detonation, Emission Factors Developed Based on Phase III Testing Conducted at Dugway Proving Ground, Utah*, MACTEC Federal Programs, Inc., Research Triangle Park, NC, June 2007.

This page left blank intentionally.

15.5.9 G955, M18 Violet Smoke Hand Grenade

15.5.9.1 Ordnance Description[1,2]

The M18 Violet Smoke Hand Grenade (DODIC G955) is a colored-smoke hand grenade used for ground-to-air or ground-to-ground signaling. When used, the grenade will emit a violet smoke for 50 to 90 seconds. This ammunition is used during combat and on firing ranges during training.

The M18 Violet Smoke Hand Grenade consists of a 5.75 inch long by 2.5 inch diameter cylindrical body made of sheet metal. An M201A1 pyrotechnic delay-detonating fuse is used to function the grenade 0.7 to 2 seconds after a safety lever is released. The body of the fuse contains a primer, first fire mixture, pyrotechnic delay column, and ignition mixture. Attached to the body of the grenade are a striker, striker spring, safety lever, safety pin, and pull ring.

15.5.9.2 Emissions And Controls[2,3,5]

Particulate matter is the primary pollutant emitted from the use of the M18 Violet Smoke Hand Grenade. Other criteria pollutants, hazardous air pollutants as defined by the *Clean Air Act* (CAA), and toxic chemicals (i.e. those chemicals regulated under Section 313 of the *Emergency Planning and Community Right to Know Act* [EPCRA]) are emitted at low levels. As this ordnance is typically used in the field, there are no controls associated with its use.

Table 15.5.9-1 presents emission factors for carbon dioxide (CO_2), criteria pollutants, total nonmethane hydrocarbons (TNMHC), and total suspended particulate (TSP). Table 15.5.9-2 presents emission factors for hazardous air pollutants and toxic chemicals. In both tables, the emission factors are presented in units of pounds of emissions per item (lb per item) and in units of pounds of emissions per pound net explosive weight contained in the item (lb per lb NEW).

Table 15.5.9-1 EMISSION FACTORS FOR THE USE OF DODIC G955, M18 VIOLET SMOKE HAND GRENADE – CARBON DIOXIDE, CRITERIA POLLUTANTS, TOTAL NONMETHANE HYDROCARBONS, AND TOTAL SUSPENDED PARTICULATE[a]

EMISSION FACTOR RATING: B (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
124-38-9	CO_2	4.3 E-02	6.0 E-02
630-08-0	Carbon monoxide (CO)	1.4 E-02	1.9 E-02
7439-92-1	Lead (Pb)[f]	1.6 E-05	2.2 E-05
10102-43-9	Nitric oxide (NO)	3.9 E-04	5.4 E-04
--	Oxides of nitrogen (NO_x)	4.9 E-04	6.8 E-04
--	PM-2.5[d,f]	1.0 E-01	1.4 E-01
--	PM-10[e,f]	1.2 E-01	1.6 E-01
7446-09-5	Sulfur dioxide (SO_2)[f]	1.6 E-04	2.3 E-04
--	TNMHC[f]	1.1 E-03	1.6 E-03
12789-66-1	TSP	1.2 E-01	1.6 E-01

[a] Factors represent uncontrolled emissions. References 2, 3, and 5.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 7.20 E-01 pounds per item. Reference 2.
[d] PM-2.5 = particulate matter with an aerodynamic diameter equal to or less than 2.5 micrometers (μm).
[e] PM-10 = particulate matter with an aerodynamic diameter equal to or less than 10 μm.
[f] EMISSION FACTOR RATING C.

Table 15.5.9-2 EMISSION FACTORS FOR THE USE OF DODIC G955, M18 VIOLET SMOKE HAND GRENADE – HAZARDOUS AIR POLLUTANTS AND TOXIC CHEMICALS[a]

EMISSION FACTOR RATING: C (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
75-07-0	Acetaldehyde[d]	8.0 E-05	1.1 E-04
75-05-8	Acetonitrile[d]	2.8 E-05	3.9 E-05
107-02-8	Acrolein[d]	3.1 E-06	4.2 E-06
107-13-1	Acrylonitrile[d]	3.6 E-05	5.0 E-05
7440-39-3	Barium[d]	7.2 E-07	1.0 E-06
71-43-2	Benzene[d]	8.1 E-05	1.1 E-04
7440-41-7	Beryllium[d]	9.8 E-10	1.4 E-09
106-99-0	1,3-Butadiene[d,f]	1.2 E-05	1.7 E-05
123-72-8	Butanal[e]	1.0 E-06	1.4 E-06
75-15-0	Carbon disulfide[d,f]	1.7 E-04	2.3 E-04
56-23-5	Carbon tetrachloride[d,g]	1.1 E-06	1.5 E-06
463-58-1	Carbonyl sulfide[e]	1.5 E-05	2.1 E-05
7782-50-5	Chlorine[d]	1.6 E-06	2.3 E-06
108-90-7	Chlorobenzene[d,f]	2.4 E-06	3.3 E-06
75-00-3	Chloroethane[d,f]	2.0 E-07	2.8 E-07
67-66-3	Chloroform[d,f]	4.2 E-06	5.8 E-06
7440-47-3	Chromium[d]	3.0 E-07	4.2 E-07
7440-48-4	Cobalt[d]	4.0 E-08	5.6 E-08
95-50-1	1,2-Dichlorobenzene[e,f]	8.3 E-07	1.2 E-06
541-73-1	1,3-Dichlorobenzene[e]	1.1 E-07	1.5 E-07
75-71-8	Dichlorodifluoromethane[e]	4.9 E-08	6.7 E-08
--	Total dioxin/furan compounds[d]	4.6 E-10	6.5 E-10
100-41-4	Ethylbenzene[d]	1.0 E-06	1.4 E-06
74-85-1	Ethylene[e]	3.0 E-04	4.2 E-04
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin[d]	8.0 E-11	1.1 E-10
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran[d]	1.8 E-11	2.5 E-11
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin[d]	1.7 E-12	2.4 E-12
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin[d]	1.4 E-11	2.0 E-11
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin[d]	6.3 E-12	8.7 E-12
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran[d]	8.5 E-12	1.2 E-11

Table 15.5.9-2 (cont.)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran[d]	6.3 E-12	8.7 E-12
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran[d]	5.7 E-12	7.9 E-12
67-63-0	Isopropyl alcohol[e]	1.6 E-07	2.3 E-07
7439-92-1	Lead[d]	1.6 E-05	2.2 E-05
7439-96-5	Manganese[d]	1.1 E-06	1.5 E-06
7439-97-6	Mercury[d]	1.2 E-08	1.7 E-08
75-09-2	Methylene chloride[d]	2.0 E-06	2.7 E-06
3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin[d,f]	2.2 E-10	3.1 E-10
39001-02-0	1,2,3,4,6,7,8,9-Octachlorodibenzofuran[d]	4.6 E-11	6.4 E-11
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran[d]	6.8 E-12	9.5 E-12
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran[d]	6.3 E-12	8.7 E-12
123-38-6	Propionaldehyde[d,g]	7.1 E-07	9.8 E-07
115-07-1	Propylene[e,f]	4.3 E-05	6.0 E-05
7782-49-2	Selenium[d]	8.8 E-09	1.2 E-08
7440-22-4	Silver[e]	2.3 E-08	3.1 E-08
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran[d]	4.3 E-11	5.9 E-11
127-18-4	Tetrachloroethylene[d,g]	3.8 E-06	5.3 E-06
108-88-3	Toluene[d]	9.3 E-06	1.3 E-05
79-01-6	Trichloroethylene[d,g]	6.0 E-08	8.3 E-08
75-01-4	Vinyl chloride[d,f]	2.7 E-06	3.8 E-06
75-35-4	Vinylidene chloride[d]	2.4 E-07	3.4 E-07
106-42-3, 108-38-3	m-Xylene, p-Xylene[d,g]	1.2 E-06	1.7 E-06
95-47-6	o-Xylene[d]	9.3 E-07	1.3 E-06
7440-66-6	Zinc[e]	2.2 E-06	3.0 E-06

[a] Factors represent uncontrolled emissions. References 2, 3, and 5.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 7.2 E-01 pounds per item. Reference 2.
[d] Reportable chemical under EPCRA Section 313 and a hazardous air pollutant under CAA Section 112(b).
[e] Reportable chemical under EPCRA Section 313.
[f] EMISSION FACTOR RATING B.
[g] EMISSION FACTOR RATING D.

References for Section 15.5.9

1. *Army Ammunition Data Sheets for Grenades*, Technical Manual TM 43-0001-29 C1, Headquarters, Department of the Army, Washington, DC, June 1995.

2. *Sampling Results for AEC Phase III Training Ordnance Emission Characterization*, URS Corporation, Oak Ridge, TN, July 2001.

3. Supporting information including Excel spreadsheets supplied upon request by the U.S. Army Dugway Proving Ground test support contractor, URS Corporation, Oak Ridge, TN, January 2005.

4. *Hazard Classification of United States Military Explosives and Munitions*, U.S. Army Defense Ammunition Center, Logistics Review and Technical Assistance Office, McAlester, OK, Revision 11, February 2001.

5. *Background Document, Report on Revisions to 5th Edition AP-42 Chapter 15 - Ordnance Detonation, Emission Factors Developed Based on Phase III Testing Conducted at Dugway Proving Ground, Utah*, MACTEC Federal Programs, Inc., Research Triangle Park, NC, June 2007.

This page left blank intentionally.

15.5.10 G963, M7A3 CS Riot Control Agent Hand Grenade

15.5.10.1 Ordnance Description[1,2]

The M7A3 CS Riot Control Agent Hand Grenade (DODIC G963) is used to control counter-insurgencies and for other tactical missions. It is a burning-type riot control grenade that is filled with CS irritant agent (i.e., tear gas) and may be used to simulate casualty agents during training. When functioned, the grenade emits CS riot control agent for 15 to 35 seconds. This ammunition is used during combat and on firing ranges during training.

The M7A3 CS Riot Control Agent Hand Grenade consists of a 5.7 inch long cylindrical body made of sheet metal that is filled with CS riot control agent. An M201A1 pyrotechnic delay-igniting fuse is used to function the grenade after a safety lever is released. The body of the fuse contains a primer, first fire mixture, pyrotechnic delay column, and ignition mixture. Attached to the body of the grenade are a striker, striker spring, safety lever, safety pin, and pull ring.

15.5.10.2 Emissions And Controls[1-4]

Primary emissions from the use of the M7A3 CS Riot Control Agent Hand Grenade include carbon dioxide (CO_2), carbon monoxide (CO), and particulate matter. Other criteria pollutants, hazardous air pollutants as defined by the *Clean Air Act* (CAA), and toxic chemicals (i.e., those chemicals regulated under Section 313 of the *Emergency Planning and Community Right-to-Know Act* [EPCRA]) are emitted at low levels. As this ordnance is typically used in the field, there are no controls associated with its use.

Table 15.5.10-1 presents emission factors for CO_2, criteria pollutants, total nonmethane hydrocarbons (TNMHC), and total suspended particulate (TSP). Table 15.5.10-2 presents emission factors for hazardous air pollutants and toxic chemicals. In both tables, the emission factors are presented in units of pounds of emissions per item (lb per item) and in units of pounds of emissions per pound net explosive weight contained in the item (lb per lb NEW).

Table 15.5.10-1 EMISSION FACTORS FOR THE USE OF DODIC G963, M7A3 CS RIOT CONTROL AGENT HAND GRENADE – CARBON DIOXIDE, CRITERIA POLLUTANTS, TOTAL NONMETHANE HYDROCARBONS, AND TOTAL SUSPENDED PARTICULATE[a]

EMISSION FACTOR RATING: C

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
124-38-9	CO_2	9.1 E-02	1.1 E-01
630-08-0	CO	3.4 E-02	4.1 E-02
--	Oxides of nitrogen (NO_X)	1.4 E-03	1.7 E-03
--	PM-2.5[d]	3.7 E-02	4.5 E-02
--	PM-10[e]	4.2 E-02	5.1 E-02
7446-09-5	Sulfur dioxide (SO_2)	5.1 E-05	6.1 E-05
--	TNMHC	5.6 E-03	6.7 E-03
12789-66-1	TSP	1.8 E-02	2.2 E-02

[a] Factors represent uncontrolled emissions. References 1-4.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 7.50 E-01 pounds per item. References 1 and 5.
[d] PM-2.5 = particulate matter with an aerodynamic diameter equal to or less than 2.5 micrometers (μm).
[e] PM-10 = particulate matter with an aerodynamic diameter equal to or less than 10 μm.

Table 15.5.10-2 EMISSION FACTORS FOR THE USE OF DODIC G963, M7A3 CS RIOT CONTROL AGENT HAND GRENADE – HAZARDOUS AIR POLLUTANTS AND TOXIC CHEMICALS[a]

EMISSION FACTOR RATING: C (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
75-05-8	Acetonitrile[d]	3.3 E-04	3.9 E-04
98-86-2	Acetophenone[d]	3.3 E-06	3.9 E-06
107-02-8	Acrolein[d]	1.0 E-03	1.2 E-03
107-13-1	Acrylonitrile[d]	1.1 E-04	1.3 E-04
7664-41-7	Ammonia[e]	5.6 E-05	6.7 E-05
71-43-2	Benzene[d]	2.3 E-04	2.7 E-04
106-99-0	1,3-Butadiene[d]	1.1 E-05	1.3 E-05
123-72-8	Butyraldehyde[e]	1.2 E-05	1.5 E-05
7782-50-5	Chlorine[d,g]	4.7 E-05	5.6 E-05
108-90-7	Chlorobenzene[d]	3.6 E-04	4.4 E-04
74-87-3	Chloromethane[d]	3.9 E-05	4.7 E-05
7440-47-3	Chromium[d]	1.0 E-06	1.2 E-06
--	Total dioxin/furan compounds[d]	4.7 E-10	5.6 E-10
100-41-4	Ethylbenzene[d]	4.4 E-06	5.2 E-06
74-85-1	Ethylene[e]	1.1 E-03	1.3 E-03
86-73-7	Fluorene[f]	6.4 E-07	7.7 E-07
50-00-0	Formaldehyde[d]	5.3 E-04	6.3 E-04
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin[d]	3.3 E-11	4.0 E-11
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran[d]	2.1 E-11	2.5 E-11
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran[d]	6.7 E-12	8.0 E-12
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran[d]	1.8 E-12	2.2 E-12
7647-01-0	Hydrochloric acid[d,g]	3.5 E-04	4.2 E-04
74-90-8	Hydrogen cyanide[d]	1.0 E-03	1.2 E-03
75-09-2	Methylene chloride[d]	5.2 E-06	6.3 E-06
91-57-6	2-Methylnaphthalene[f]	1.2 E-06	1.4 E-06
95-48-7	2-Methylphenol[d]	3.5 E-06	4.1 E-06
91-20-3	Naphthalene[d]	1.2 E-05	1.4 E-05
55-63-0	Nitroglycerin[e]	4.8 E-05	5.7 E-05
3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin[d]	1.5 E-10	1.8 E-10
39001-02-0	1,2,3,4,6,7,8,9-Octachlorodibenzofuran[d,g]	1.3 E-11	1.5 E-11

Table 15.5.10-2 (cont.)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran[d]	4.5 E-11	5.4 E-11
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran[d]	4.8 E-11	5.8 E-11
85-01-8	Phenanthrene[d]	1.9 E-06	2.2 E-06
108-95-2	Phenol[d]	3.8 E-05	4.6 E-05
109-77-3	Propanedinitrile, (phenylmethylene)-[e,g]	9.3 E-05	1.1 E-04
115-07-1	Propylene[e]	2.4 E-04	2.9 E-04
7782-49-2	Selenium[d]	9.9 E-08	1.2 E-07
100-42-5	Styrene[d]	1.7 E-05	2.0 E-05
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran[d]	1.4 E-10	1.7 E-10
108-88-3	Toluene[d]	6.4 E-05	7.7 E-05
75-01-4	Vinyl chloride[d]	1.2 E-05	1.5 E-05
7440-66-6	Zinc[e]	6.5 E-05	7.8 E-05

[a] Factors represent uncontrolled emissions. References 1-4.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 7.50 E-01 pounds per item. References 1 and 5.
[d] Reportable chemical under EPCRA Section 313 and a hazardous air pollutant under CAA Section 112(b).
[e] Reportable chemical under EPCRA Section 313.
[f] Hazardous air pollutant under CAA Section 112(b).
[g] EMISSION FACTOR RATING D.

References For Section 15.5.10

1. *Sampling Results for AEC Phase VI Emission Characterization of Exploding Ordnance and Smoke/Pyrotechnics,* URS Group, Inc., Oak Ridge, TN, April 2006.

2. *Detailed Test Plan for Phase VI Emission Characterization of Exploding Ordnance and Smoke/Pyrotechnics,* West Desert Test Center, U.S. Army Dugway Proving Ground, UT, June 2004.

3. Supporting information including Excel spreadsheets supplied upon request by the U.S. Army Dugway Proving Ground test support contractor, URS Group, Inc., Oak Ridge, TN, February 2007.

4. *Background Document, Report on Revisions to 5th Edition AP-42 Chapter 15 - Ordnance Detonation, Emission Factors Developed Based on Phase VI Testing Conducted at Dugway Proving Ground, Utah,* MACTEC Federal Programs, Inc., Research Triangle Park, NC, June 2008.

5. *Munitions Items Disposition Action System (MIDAS)* website, https://midas.dac.army.mil/, U.S. Army Defense Ammunition Center, McAlester, OK, December 2007.

15.5.11 G978, M82 Simulant Screening Smoke Launcher Grenade

15.5.11.1 Ordnance Description[1,2]

The M82 Simulant Screening Smoke Launcher Grenade (DODIC G978) is used with the M239, M243, M250, and similar grenade launchers to provide a means to train armored/tactical vehicle crews to use smoke grenade launchers. When used, the grenade will produce a white smoke cloud that lasts for 45 to 60 seconds. This ammunition is used on firing ranges during training; it is not used during combat.

The M82 Simulant Screening Smoke Launcher Grenade consists of a plastic cylindrical body that contains a propellant assembly, smoke composition, burster, booster lead, and safe and arm mechanism. The propellant assembly consists of a pyrotechnic delay detonator, launch propellant, and electric match. When initiated, the launch propellant expels the grenade from the launcher. Approximately 1.7 seconds later, the delay element initiates the burster charge which ruptures the plastic grenade body and disperses the smoke mixture, forming the smoke screen.

15.5.11.2 Emissions And Controls[1-4]

Particulate matter, carbon dioxide (CO_2), and carbon monoxide (CO) are the primary pollutants emitted from the use of the M82 Simulant Screening Smoke Launcher Grenade. Other criteria pollutants, hazardous air pollutants as defined by the *Clean Air Act* (CAA), and toxic chemicals (i.e. those chemicals regulated under Section 313 of the *Emergency Planning and Community Right to Know Act* [EPCRA]) are emitted at low levels. As this ordnance is typically used in the field, there are no controls associated with its use.

Table 15.5.11-1 presents emission factors for CO_2, criteria pollutants, total nonmethane hydrocarbons (TNMHC), and total suspended particulate (TSP). Table 15.5.11-2 presents emission factors for hazardous air pollutants and toxic chemicals. In both tables, the emission factors are presented in units of pounds of emissions per item (lb per item) and in units of pounds of emissions per pound net explosive weight contained in the item (lb per lb NEW).

Table 15.5.11-1 EMISSION FACTORS FOR THE USE OF DODIC G978, M82 SIMULANT SCREENING SMOKE LAUNCHER GRENADE– CARBON DIOXIDE, CRITERIA POLLUTANTS, TOTAL NONMETHANE HYDROCARBONS, AND TOTAL SUSPENDED PARTICULATE[a]

EMISSION FACTOR RATING: C

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
124-38-9	CO_2	1.5 E-02	8.9 E-03
630-08-0	CO	1.2 E-02	7.3 E-03
7439-92-1	Lead (Pb)	3.6 E-05	2.2 E-05
--	Oxides of nitrogen (NO_x)	4.4 E-04	2.6 E-04
--	PM-2.5[d]	2.9 E-02	1.7 E-02
--	PM-10[e]	5.3 E-02	3.1 E-02
--	TNMHC	2.0 E-03	1.2 E-03
12789-66-1	TSP	4.9 E-02	2.9 E-02

[a] Factors represent uncontrolled emissions. References 1-4.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 1.68 pounds per item. Reference 5.
[d] PM-2.5 = particulate matter with an aerodynamic diameter equal to or less than 2.5 micrometers (μm).
[e] PM-10 = particulate matter with an aerodynamic diameter equal to or less than 10 μm.

Table 15.5.11-2 EMISSION FACTORS FOR THE USE OF DODIC G978, M82 SIMULANT SCREENING SMOKE LAUNCHER GRENADE– HAZARDOUS AIR POLLUTANTS AND TOXIC CHEMICALS[a]

EMISSION FACTOR RATING: C (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
75-07-0	Acetaldehyde[d]	8.5 E-05	5.1 E-05
75-05-8	Acetonitrile[d,g]	2.2 E-03	1.3 E-03
107-02-8	Acrolein[d]	3.9 E-05	2.3 E-05
7429-90-5	Aluminum[e]	2.4 E-04	1.4 E-04
7440-36-0	Antimony[d]	1.8 E-07	1.1 E-07
7440-39-3	Barium[e]	2.0 E-05	1.2 E-05
71-43-2	Benzene[d]	4.7 E-05	2.8 E-05
67-56-1	Benzene, 2-ethyl-3-methyl-[d,g]	2.8 E-06	1.6 E-06
106-99-0	1,3-Butadiene[d]	3.8 E-05	2.2 E-05
85-68-7	Butylbenzylphthalate[f]	2.1 E-07	1.3 E-07
123-72-8	Butyraldehyde[e]	3.7 E-05	2.2 E-05
7440-43-9	Cadmium[d]	3.3 E-07	1.9 E-07
7440-47-3	Chromium[d]	1.2 E-06	7.0 E-07
7440-48-4	Cobalt[d]	4.1 E-08	2.4 E-08
7440-50-8	Copper[e]	4.5 E-06	2.7 E-06
4170-30-3	Crotonaldehyde[e]	9.9 E-06	5.9 E-06
131-11-3	Dimethyl phthalate[d,g]	2.7 E-07	1.6 E-07
--	Total dioxin/furan compounds[d]	1.9 E-08	1.2 E-08
74-85-1	Ethylene[e]	4.8 E-04	2.8 E-04
117-81-7	bis(2-Ethylhexyl)phthalate[d]	3.8 E-06	2.2 E-06
50-00-0	Formaldehyde[d]	4.6 E-05	2.7 E-05
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin[d]	2.4 E-09	1.4 E-09
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran[d,g]	1.4 E-09	8.4 E-10
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran[d]	1.2 E-09	7.2 E-10
74-90-8	Hydrogen cyanide[d]	6.2 E-04	3.7 E-04
7439-92-1	Lead[d]	3.6 E-05	2.2 E-05
7439-96-5	Manganese[d]	1.1 E-06	6.4 E-07
75-09-2	Methylene chloride[d]	7.9 E-06	4.7 E-06
91-57-6	2-Methylnaphthalene[f]	3.3 E-07	2.0 E-07
91-20-3	Naphthalene[d]	1.4 E-06	8.4 E-07

Table 15.5.11-2 (cont.)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
7440-02-0	Nickel[d]	7.6 E-07	4.5 E-07
3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin[d]	1.1 E-08	6.4 E-09
39001-02-0	1,2,3,4,6,7,8,9-Octachlorodibenzofuran[d,g]	3.6 E-09	2.1 E-09
108-95-2	Phenol[d,g]	9.4 E-07	5.6 E-07
123-38-6	Propionaldehyde[d]	9.7 E-06	5.8 E-06
110-86-1	Pyridine[e,g]	4.0 E-07	2.4 E-07
7440-28-0	Thallium[e]	6.9 E-08	4.1 E-08
108-88-3	Toluene[d]	2.6 E-05	1.5 E-05
7440-66-6	Zinc[e]	5.1 E-06	3.0 E-06

[a] Factors represent uncontrolled emissions. References 1-4.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 1.68 pounds per item. Reference 5.
[d] Reportable chemical under EPCRA Section 313 and a hazardous air pollutant under CAA Section 112(b).
[e] Reportable chemical under EPCRA Section 313.
[f] Hazardous air pollutant under CAA Section 112(b).
[g] EMISSION FACTOR RATING D.

References for Section 15.5.11

1. *Sampling Results for AEC Phase V Emission Characterization of Exploding Ordnance and Smoke/Pyrotechnics, Revision 1*, URS Group, Inc., Oak Ridge, TN, February 2007.

2. *Detailed Test Plan for Phase V Emission Characterization of Exploding Ordnance and Smoke/Pyrotechnics*, West Desert Test Center, U.S. Army Dugway Proving Ground, UT, October 2003.

3. Supporting information including Excel spreadsheets supplied upon request by the U.S. Army Dugway Proving Ground test support contractor, URS Group, Inc., Oak Ridge, TN, January 2006 and February 2007.

4. *Background Document, Report on Revisions to 5th Edition AP-42 Chapter 15 - Ordnance Detonation, Emission Factors Developed Based on Phase V-B Testing Conducted at Dugway Proving Ground, Utah*, MACTEC Federal Programs, Inc., Research Triangle Park, NC, November 2007.

5. *Munitions Items Disposition Action System (MIDAS)* website, https://midas.dac.army.mil/, U.S. Army Defense Ammunition Center, McAlester, OK, November 2006.

15.5.12 G982, M83 Terephthalic Acid (TA) Smoke Practice Hand Grenade

15.5.12.1 Ordnance Description[1,2]

The M83 Terephthalic Acid (TA) Smoke Practice Hand Grenade (DODIC G982) is a burning-type hand grenade used to generate smoke for screening of small units and for ground-to-air or ground-to-ground signaling. When used, the grenade will emit a white smoke for 25 to 70 seconds. This ammunition is used on firing ranges during training; it is not used during combat.

The M83 TA Smoke Practice Hand Grenade consists of a cylindrical body made of sheet metal that is filled with TA smoke mixture. An M201A1 pyrotechnic delay-igniting fuse is used to function the grenade after a safety lever is released. The body of the fuse contains a primer, first fire mixture, pyrotechnic delay column, and starter slug. Attached to the body of the grenade are a striker, striker spring, safety lever, safety pin, and pull ring.

15.5.12.2 Emissions And Controls[1-4]

Carbon dioxide (CO_2) is the primary pollutant emitted from the use of the M83 TA Smoke Practice Hand Grenade. Criteria pollutants, hazardous air pollutants as defined by the *Clean Air Act* (CAA), and toxic chemicals (i.e. those chemicals regulated under Section 313 of the *Emergency Planning and Community Right to Know Act* [EPCRA]) are emitted at low levels. As this ordnance is typically used in the field, there are no controls associated with its use.

Table 15.5.12-1 presents emission factors for CO_2, criteria pollutants, total nonmethane hydrocarbons (TNMHC), and total suspended particulate (TSP). Table 15.5.12-2 presents emission factors for hazardous air pollutants and toxic chemicals. In both tables, the emission factors are presented in units of pounds of emissions per item (lb per item) and in units of pounds of emissions per pound net explosive weight contained in the item (lb per lb NEW).

Table 15.5.12-1 EMISSION FACTORS FOR THE USE OF DODIC G982, M83 TA SMOKE PRACTICE HAND GRENADE – CARBON DIOXIDE, CRITERIA POLLUTANTS, TOTAL NONMETHANE HYDROCARBONS, AND TOTAL SUSPENDED PARTICULATE[a]

EMISSION FACTOR RATING: C (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
124-38-9	CO_2	1.3 E-01	1.9 E-01
630-08-0	Carbon monoxide (CO)	1.8 E-02	2.5 E-02
7439-92-1	Lead (Pb)[f]	5.8 E-05	8.3 E-05
--	Oxides of nitrogen (NO_x)	3.5 E-04	5.1 E-04
--	PM-2.5[d]	2.8 E-02	4.0 E-02
--	PM-10[e]	3.6 E-02	5.2 E-02
7446-09-5	Sulfur dioxide (SO_2)	9.5 E-06	1.4 E-05
--	TNMHC	9.5 E-03	1.3 E-02
12789-66-1	TSP	4.7 E-02	6.7 E-02

[a] Factors represent uncontrolled emissions. References 1-4.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 7.02 E-01 pounds per item. Reference 5.
[d] PM-2.5 = particulate matter with an aerodynamic diameter equal to or less than 2.5 micrometers (μm).
[e] PM-10 = particulate matter with an aerodynamic diameter equal to or less than 10 μm.
[f] EMISSION FACTOR RATING D.

Table 15.5.12-2 EMISSION FACTORS FOR THE USE OF DODIC G982, M83 TA SMOKE PRACTICE HAND GRENADE – HAZARDOUS AIR POLLUTANTS AND TOXIC CHEMICALS[a]

EMISSION FACTOR RATING: C (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
83-32-9	Acenaphthene[d]	2.0 E-07	2.8 E-07
208-96-8	Acenaphthylene[d]	4.4 E-07	6.3 E-07
75-07-0	Acetaldehyde[e]	2.0 E-05	2.9 E-05
79-11-8	Acetic acid, chloro-[e,g]	1.6 E-06	2.2 E-06
75-05-8	Acetonitrile[e]	4.6 E-06	6.6 E-06
98-86-2	Acetophenone[e]	1.8 E-05	2.6 E-05
107-02-8	Acrolein[e]	4.2 E-04	6.0 E-04
7429-90-5	Aluminum[f]	5.9 E-06	8.5 E-06
7664-41-7	Ammonia[f,g]	4.9 E-06	7.0 E-06
120-12-7	Anthracene[e]	8.1 E-08	1.2 E-07
7440-36-0	Antimony[e,g]	2.9 E-05	4.1 E-05
7440-38-2	Arsenic[e]	1.2 E-08	1.7 E-08
7440-39-3	Barium[f,g]	2.2 E-05	3.2 E-05
71-43-2	Benzene[e]	5.5 E-03	7.8 E-03
205-99-2	Benzo[b]fluoranthene[e]	1.8 E-07	2.6 E-07
92-52-4	Biphenyl[e,g]	8.8 E-06	1.3 E-05
106-99-0	1,3-Butadiene[e]	8.0 E-05	1.1 E-04
123-72-8	Butyraldehyde[f]	2.7 E-06	3.8 E-06
74-87-3	Chloromethane[e]	7.5 E-05	1.1 E-04
7440-47-3	Chromium[e]	4.3 E-06	6.1 E-06
218-01-9	Chrysene[e]	4.4 E-06	6.3 E-06
7440-50-8	Copper[f,g]	8.0 E-08	1.1 E-07
4170-30-3	Crotonaldehyde[f]	1.1 E-05	1.5 E-05
132-64-9	Dibenzofuran[e]	9.0 E-06	1.3 E-05
120-83-2	2,4-Dichlorophenol[f]	1.2 E-05	1.8 E-05
606-20-2	2,6-Dinitrotoluene[f]	1.2 E-06	1.8 E-06
--	Total dioxin/furan compounds[e]	2.1 E-10	3.0 E-10
74-85-1	Ethylene[f]	7.1 E-04	1.0 E-03
206-44-0	Fluoranthene[e]	2.9 E-07	4.1 E-07
86-73-7	Fluorene[d]	7.9 E-06	1.1 E-05

Table 15.5.12-2 (cont.)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
50-00-0	Formaldehyde[e]	2.0 E-04	2.9 E-04
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin[e]	2.7 E-11	3.8 E-11
67562-39-4	1,2,3,4,6,7,8-Heptachlorodibenzofuran[e]	6.3 E-13	9.0 E-13
39227-28-6	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin[e]	2.6 E-11	3.7 E-11
57653-85-7	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin[e]	1.6 E-11	2.3 E-11
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin[e]	2.7 E-11	3.8 E-11
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran[e]	1.3 E-12	1.9 E-12
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran[e]	6.9 E-13	9.8 E-13
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran[e]	1.6 E-12	2.3 E-12
74-90-8	Hydrogen cyanide[e]	5.0 E-05	7.2 E-05
7439-92-1	Lead[e,g]	5.8 E-05	8.3 E-05
7439-96-5	Manganese[e]	6.0 E-07	8.6 E-07
91-57-6	2-Methylnaphthalene[d]	8.6 E-07	1.2 E-06
95-48-7	2-Methylphenol[e]	7.2 E-06	1.0 E-05
91-20-3	Naphthalene[e]	1.3 E-05	1.8 E-05
7440-02-0	Nickel[e]	3.1 E-06	4.4 E-06
98-95-3	Nitrobenzene[e]	3.0 E-05	4.3 E-05
88-75-5	2-Nitrophenol[f]	7.4 E-07	1.1 E-06
3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin[e]	7.1 E-12	1.0 E-11
40321-76-4	1,2,3,7,8-Pentachlorodibenzo-p-dioxin[e]	6.0 E-11	8.5 E-11
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran[e]	1.2 E-12	1.7 E-12
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran[e]	3.3 E-12	4.7 E-12
85-01-8	Phenanthrene[e]	8.7 E-07	1.2 E-06
108-95-2	Phenol[e]	2.9 E-04	4.2 E-04
7723-14-0	Phosphorus[d]	5.1 E-07	7.3 E-07
123-38-6	Propionaldehyde[e]	7.9 E-07	1.1 E-06
115-07-1	Propylene[f]	2.3 E-04	3.2 E-04
129-00-0	Pyrene[d]	5.9 E-07	8.4 E-07
7782-49-2	Selenium[e,g]	2.9 E-08	4.1 E-08
1746-01-6	2,3,7,8-Tetrachlorodibenzo-p-dioxin[e]	3.6 E-11	5.1 E-11
51207-31-9	2,3,7,8-Tetrachlorodibenzofuran[e]	2.0 E-12	2.8 E-12
7440-28-0	Thallium[f]	1.1 E-07	1.6 E-07
108-88-3	Toluene[e]	7.3 E-05	1.0 E-04

Table 15.5.12-2 (cont.)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
95-95-4	2,4,5-Trichlorophenol[e,g]	4.1 E-07	5.8 E-07
88-06-2	2,4,6-Trichlorophenol[e]	1.1 E-05	1.6 E-05
7440-66-6	Zinc[f]	1.3 E-05	1.9 E-05

[a] Factors represent uncontrolled emissions. References 1-4.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 7.02 E-01 pounds per item. Reference 5.
[d] Hazardous air pollutant under CAA Section 112(b).
[e] Reportable chemical under EPCRA Section 313 and a hazardous air pollutant under CAA Section 112(b).
[f] Reportable chemical under EPCRA Section 313.
[g] EMISSION FACTOR RATING D.

References for Section 15.5.12

1. *Sampling Results for AEC Phase V Emission Characterization of Exploding Ordnance and Smoke/Pyrotechnics, Revision 1*, URS Group, Inc., Oak Ridge, TN, February 2007.

2. *Detailed Test Plan for Phase V Emission Characterization of Exploding Ordnance and Smoke/Pyrotechnics*, West Desert Test Center, U.S. Army Dugway Proving Ground, UT, October 2003.

3. Supporting information including Excel spreadsheets supplied upon request by the U.S. Army Dugway Proving Ground test support contractor, URS Group, Inc., Oak Ridge, TN, January 2006 and February 2007.

4. *Background Document, Report on Revisions to 5th Edition AP-42 Chapter 15 - Ordnance Detonation, Emission Factors Developed Based on Phase V-A Testing Conducted at Dugway Proving Ground, Utah*, MACTEC Federal Programs, Inc., Research Triangle Park, NC, November 2007.

5. *Munitions Items Disposition Action System (MIDAS)* website, https://midas.dac.army.mil/, U.S. Army Defense Ammunition Center, McAlester, OK, November 2006.

This page left blank intentionally.

15.5.14 G815, L8A3 Red Phosphorus Smoke Screening Grenade Launcher (UK)

15.5.14.1 Ordnance Description[1,2]

The L8A3 Red Phosphorus Smoke Screening Grenade Launcher (UK) (DODIC G815) is a burning-type grenade that is used to provide a self-screening smoke capability for armored tactical vehicles. It is used with the M239 and similar grenade launchers and will produce a dense white smoke cloud away from the vehicle. This ammunition is used during combat and on firing ranges during training.

The L8A3 Red Phosphorus Smoke Screening Grenade Launcher (UK) consists of cylindrical rubber body with a metal base. The body contains a firing clip, fuse, propellant charge, delay assembly, burster charge, and red phosphorous smoke composition. The grenade is propelled from the launching device when electrical current at the firing clip activates the electrical squib-type fuse, which ignites the propellant charge and simultaneously ignites the delay composition. After the delay composition is expended, the burster charge is ignited as well as the smoke composition.

15.5.14.2 Emissions And Controls[1-4]

The primary emissions from the use of the L8A3 Red Phosphorus Smoke Screening Grenade Launcher (UK)are carbon dioxide (CO_2) and particulate matter. Other criteria pollutants, hazardous air pollutants as defined by the *Clean Air Act* (CAA), and toxic chemicals (i.e. those chemicals regulated under Section 313 of the *Emergency Planning and Community Right to Know Act* [EPCRA]) are emitted at low levels. As this ordnance is typically used in the field, there are no controls associated with its use.

Table 15.5.14-1 presents emission factors for CO_2, criteria pollutants, total nonmethane hydrocarbons (TNMHC), and total suspended particulate (TSP). Table 15.5.14-2 presents emission factors for hazardous air pollutants and toxic chemicals. In both tables, the emission factors are presented in units of pounds of emissions per item (lb per item) and in units of pounds of emissions per pound net explosive weight contained in the item (lb per lb NEW).

Table 15.5.14-1 EMISSION FACTORS FOR THE USE OF DODIC G815, L8A3 RED PHOSPHORUS SMOKE SCREENING GRENADE LAUNCHER (UK) – CARBON DIOXIDE, CRITERIA POLLUTANTS, TOTAL NONMETHANE HYDROCARBONS, AND TOTAL SUSPENDED PARTICULATE[a]

EMISSION FACTOR RATING: A (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
124-38-9	CO_2	1.7 E-01	2.1 E-01
630-08-0	Carbon monoxide (CO)	2.0 E-02	2.3 E-02
7439-92-1	Lead (Pb)[g]	3.0 E-06	3.6 E-06
--	Oxides of nitrogen (NO_x)[f]	1.6 E-03	1.9 E-03
--	PM-2.5[d,f]	7.9 E-01	9.5 E-01
--	PM-10[e]	8.0 E-01	9.6 E-01
7446-09-5	Sulfur dioxide (SO_2)[g]	1.2 E-03	1.5 E-03
--	TNMHC[f]	3.9 E-03	4.7 E-03
12789-66-1	TSP	8.1 E-01	9.7 E-01

[a] Factors represent uncontrolled emissions. References 1-4.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 8.32 E-01 pounds per item. References 1 and 5.
[d] PM-2.5 = particulate matter with an aerodynamic diameter equal to or less than 2.5 micrometers (μm).
[e] PM-10 = particulate matter with an aerodynamic diameter equal to or less than 10 μm.
[f] EMISSION FACTOR RATING B.
[g] EMISSION FACTOR RATING C.

Table 15.5.14-2 EMISSION FACTORS FOR THE USE OF DODIC G815, L8A3 RED PHOSPHORUS SMOKE SCREENING GRENADE LAUNCHER (UK) – HAZARDOUS AIR POLLUTANTS AND TOXIC CHEMICALS[a]

EMISSION FACTOR RATING: C (except as noted)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
83-32-9	Acenaphthene[d]	1.3 E-06	1.5 E-06
208-96-8	Acenaphthylene[d]	2.4 E-05	2.9 E-05
75-05-8	Acetonitrile[e,g]	3.5 E-04	4.3 E-04
98-86-2	Acetophenone[e]	4.8 E-06	5.8 E-06
107-02-8	Acrolein[e]	3.0 E-05	3.6 E-05
107-13-1	Acrylonitrile[e]	5.4 E-06	6.5 E-06
120-12-7	Anthracene[e]	1.7 E-06	2.0 E-06
7440-36-0	Antimony[e,h]	9.4 E-06	1.1 E-05
7440-38-2	Arsenic[e]	7.6 E-06	9.1 E-06
71-43-2	Benzene[e,g]	8.7 E-04	1.0 E-03
56-55-3	Benzo[a]anthracene[e]	5.4 E-06	6.5 E-06
205-99-2	Benzo[b]fluoranthene[e]	6.8 E-06	8.2 E-06
207-08-9	Benzo[k]fluoranthene[e]	2.5 E-06	3.0 E-06
191-24-2	Benzo[g,h,i]perylene[e]	3.0 E-06	3.6 E-06
92-52-4	Biphenyl[e,h]	8.2 E-06	9.8 E-06
106-99-0	1,3-Butadiene[e]	1.4 E-04	1.7 E-04
75-15-0	Carbon disulfide[e]	2.8 E-05	3.3 E-05
75-00-3	Chloroethane[e]	3.4 E-06	4.1 E-06
7440-47-3	Chromium[e,g]	1.0 E-05	1.2 E-05
218-01-9	Chrysene[e]	6.8 E-06	8.1 E-06
7440-50-8	Copper[f]	8.9 E-07	1.1 E-06
4170-30-3	Crotonaldehyde[f]	2.2 E-06	2.7 E-06
53-70-3	Dibenz[a,h]anthracene[e]	1.1 E-06	1.3 E-06
132-64-9	Dibenzofuran[e]	2.9 E-06	3.5 E-06
131-11-3	Dimethyl phthalate[e]	4.7 E-07	5.7 E-07
--	Total dioxin/furan compounds[e,g]	3.1 E-10	3.7 E-10
122-39-4	Diphenylamine[e,h]	8.8 E-07	1.1 E-06
100-41-4	Ethylbenzene[e]	1.8 E-05	2.2 E-05
74-85-1	Ethylene[f,g]	9.3 E-04	1.1 E-03
206-44-0	Fluoranthene[e]	2.0 E-05	2.4 E-05

Table 15.5.14-2 (cont.)

CASRN[b]	Pollutant	lb per item	lb per lb NEW[c]
86-73-7	Fluorene[d]	9.0 E-06	1.1 E-05
35822-46-9	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin[e,g]	5.5 E-12	6.7 E-12
55673-89-7	1,2,3,4,7,8,9-Heptachlorodibenzofuran[e,h]	3.0 E-12	3.6 E-12
118-74-1	Hexachlorobenzene[e]	1.4 E-06	1.7 E-06
19408-74-3	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin[e,h]	9.3 E-13	1.1 E-12
70648-26-9	1,2,3,4,7,8-Hexachlorodibenzofuran[e,h]	5.5 E-12	6.6 E-12
57117-44-9	1,2,3,6,7,8-Hexachlorodibenzofuran[e]	2.0 E-12	2.4 E-12
60851-34-5	2,3,4,6,7,8-Hexachlorodibenzofuran[e]	1.3 E-12	1.6 E-12
7647-01-0	Hydrochloric acid[e,h]	1.7 E-03	2.0 E-03
74-90-8	Hydrogen cyanide[e,h]	5.1 E-05	6.1 E-05
193-39-5	Indeno[1,2,3-cd]pyrene[e]	2.8 E-06	3.4 E-06
7439-92-1	Lead[e]	3.0 E-06	3.6 E-06
7439-96-5	Manganese[e,g]	8.5 E-07	1.0 E-06
91-57-6	2-Methylnaphthalene[d]	2.4 E-05	2.9 E-05
95-48-7	2-Methylphenol[e]	1.8 E-06	2.2 E-06
91-20-3	Naphthalene[e]	1.4 E-04	1.7 E-04
86-30-6	N-Nitrosodiphenylamine[e,h]	1.1 E-06	1.4 E-06
3268-87-9	1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin[e]	4.6 E-11	5.5 E-11
57117-41-6	1,2,3,7,8-Pentachlorodibenzofuran[e,h]	1.2 E-12	1.5 E-12
57117-31-4	2,3,4,7,8-Pentachlorodibenzofuran[e,h]	2.6 E-12	3.1 E-12
85-01-8	Phenanthrene[e]	3.5 E-05	4.2 E-05
108-95-2	Phenol[e]	2.2 E-05	2.6 E-05
7723-14-0	Phosphorus[d]	2.2 E-01	2.7 E-01
123-38-6	Propionaldehyde[e,h]	3.3 E-06	3.9 E-06
115-07-1	Propylene[f,g]	2.0 E-04	2.5 E-04
129-00-0	Pyrene[d]	5.4 E-06	6.5 E-06
100-42-5	Styrene[e]	6.6 E-05	7.9 E-05
108-88-3	Toluene[e,g]	2.6 E-04	3.1 E-04
95-63-6	1,2,4-Trimethylbenzene[f]	5.8 E-06	7.0 E-06
106-42-3, 108-38-3	m-Xylene, p-Xylene[e]	8.0 E-05	9.6 E-05
95-47-6	o-Xylene[e]	1.3 E-05	1.6 E-05
7440-66-6	Zinc[f]	9.1 E-06	1.1 E-05

Table 15.5.14-2 (cont.)

[a] Factors represent uncontrolled emissions. References 1-4.
[b] CASRN = Chemical Abstracts Service Registry Number.
[c] NEW = net explosive weight. The NEW for this ordnance is 8.32 E-01 pounds per item. References 1 and 5.
[d] Hazardous air pollutant under CAA Section 112(b).
[e] Reportable chemical under EPCRA Section 313 and a hazardous air pollutant under CAA Section 112(b).
[f] Reportable chemical under EPCRA Section 313.
[g] EMISSION FACTOR RATING B.
[h] EMISSION FACTOR RATING D.

References for Section 15.5.14

1. *Sampling Results for AEC Phase VII Emission Characterization of Exploding Ordnance and Smoke/Pyrotechnics*, URS Group, Inc., Oak Ridge, TN, April 2007.

2. *Detailed Test Plan for Phase VII Emission Characterization of Exploding Ordnance and Smoke/Pyrotechnics*, West Desert Test Center, U.S. Army Dugway Proving Ground, UT, February 2005.

3. Supporting information including Excel spreadsheets supplied upon request by the U.S. Army Dugway Proving Ground test support contractor, URS Group, Inc., Oak Ridge, TN, August 2007.

4. *Background Document, Report on Revisions to 5th Edition AP-42 Chapter 15 - Ordnance Detonation, Emission Factors Developed Based on Phase VII Testing Conducted at Dugway Proving Ground, Utah*, MACTEC Federal Programs, Inc., Research Triangle Park, NC, June 2008.

5. *Munitions Items Disposition Action System (MIDAS)* website, https://midas.dac.army.mil/, U.S. Army Defense Ammunition Center, McAlester, OK, December 2007.

This page left blank intentionally.

15.5.15 Updates Since July 2006

Section 15.5 was created during July 2006. Revisions to this section since that date are summarized below.

Revision 5, June 2008

- Section 15.5.1, which presents emission factors for DODIC G878, the M228 Practice Hand Grenade Fuse, was added.
- Section 15.5.10, which presents emission factors for DODIC G963, the M7A3 CS Riot Control Agent Hand Grenade, was added.
- Section 15.5.14, which presents emission factors for DODIC G815, the L8A3 Red Phosphorus Smoke Screening Grenade Launcher (UK), was added.

Revision 4, November 2007

- Section 15.5.5, which presents emission factors for DODIC G930, the AN-M8 Hexachloroethane (HC) Smoke Hand Grenade, was added.
- Section 15.5.11, which presents emission factors for DODIC G978, the M82 Simulant Screening Smoke Launcher Grenade, was added.
- Section 15.5.12, which presents emission factors for DODIC G982, the M83 Terephthalic Acid (TA) Smoke Practice Hand Grenade, was added.

Revision 3, June 2007

- Section 15.5.6, which presents emission factors for DODIC G940, the M18 Green Smoke Hand Grenade, was added.
- Section 15.5.7, which presents emission factors for DODIC G945, the M18 Yellow Smoke Hand Grenade, was added.
- Section 15.5.8, which presents emission factors for DODIC G950, the M18 Red Smoke Hand Grenade, was added.
- Section 15.5.9, which presents emission factors for DODIC G955, the M18 Violet Smoke Hand Grenade, was added.

Revision 2, September 2006

- Section 15.5.4, which presents emission factors for DODIC G911, the MK3A2 Offensive Hand Grenade, was updated to include additional data.

Revision 1, July 2006

- Section 15.5.3, which presents emission factors for DODIC G900, the TH3 AN-M14 Incendiary Grenade, was added.